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A
FIRST BOOK OF BOTANY.

A

FIRST BOOK OF BOTANY.

FOR THE USE OF

SCHOOLS AND PRIVATE FAMILIES.

BY

WILLIAM ROSSITER,

FELLOW OF THE WORKING MEN'S COLLEGE.

LONDON:
T. J. ALLMAN, 463, OXFORD STREET.
1866.

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PREFACE.

THIS little book is meant for school children, and to be a first book for them. What is easy to understand I have tried to put simply before them; what is difficult to understand I have merely stated as simple facts, or left unmentioned.

The two leading ideas of the book are, (1), to give children a broad idea of the general structure of plants, without embarrassing them with minute details; and (2), to give them a broad idea of the principles of classification, without puzzling them with minute differences.

W. R.

WORKING MEN'S COLLEGE,
London, January, 1866.

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A

FIRST BOOK OF BOTANY.

PART I.

DESCRIPTION OF PLANTS.

INTRODUCTION.

DIFFERENT PARTS OF A PLANT.

§ 1. WHEN a seed is put into the ground and begins to grow, it does so in two directions, up and down. The part sent up from the seed is called the **stem**; the part growing down into the earth is called the **root**.

The stem forms the **trunk**, or body of the plant bearing the **branches**, **leaves**, **flowers**, **fruits**, &c., while the root serves to keep the plant fixed in the ground, and to draw up from the ground the food which it requires.

The **branches** grow out from the stem on all sides; and from these grow first the **leaves**, then the **flowers**, which afterwards become the **fruit**. The fruit contains **seed**, which in turn produces other plants.

These parts—root, stem, branches, leaves, flowers, and fruit—make up the entire plant. The root fixes and feeds it, the stem supports the branches, the branches bear the leaves; the leaves are the breathing part of the plant, and the flowers and fruit bear the seed of new plants.

The root is sometimes thick and round, as in the turnip, where it is the chief part of the plant; sometimes a mere hair, as in some of the grasses. The stem may be lofty and of great thickness, as in the oak or beech tree; or thin and weak, as in grasses, or almost entirely absent, as in the crocus, where the branches spring almost directly from the root.

So with the branches, the leaves, the flowers, and the fruit, they may be, comparatively, very large, very small, or almost entirely absent. Still, every plant has, in however slight a degree it may be, these parts—root, stem, leaves, flowers, fruit.

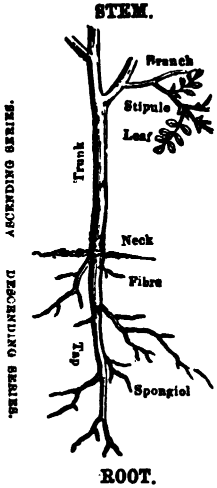


Fig. 1.

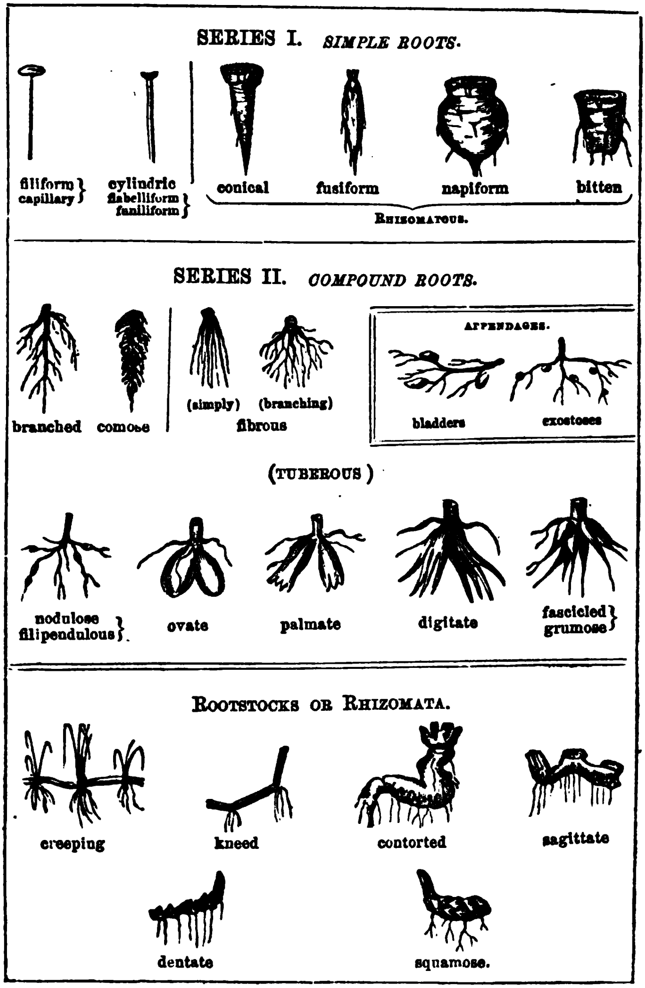
Fig. 1 shows the **rising stem**, with branches, leaves, &c., and the **descending** root, with its **fibres** and **spongioles**. The part marked **neck** is not any actual portion between the stem and root. The name of **neck** is given to that part of the plant where the stem and the root meet. This is generally at the surface of the ground, but sometimes lower.

Each part of a plant—the root, stem, branches, leaves, flowers and fruit—will be here separately described; then the entire plant will be taken, and the processes of growth, nourishment, decay, and reproduction explained.

THE ROOT.

§ 2. Plate I. shews the different forms of roots, arranged in two classes, simple and compound. Roots that branch off into fibres or other divisions are called compound. Roots that do not so divide are called simple.

PLATE I.—FORMS OF ROOTS.



Simple roots. The simplest of all roots is the **filiform**, or root consisting of one fine fibre, as in the duckweeds, fig. 2. If the fibre be thicker it is called **cylindrical**, as in fig. 3.

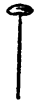


Fig. 2.

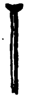


Fig. 3.

These two are the only really simple roots, but the term **simple** is generally given also to roots in which the fibres grow together, and form a fleshy substance, called a **tap**, which serves the purpose of nourishing the plant when young.

Four roots of this kind are shewn in Plate I., in the group marked **rhizomatous**. Fig. 4 shows the root of the carrot, thick at the upper end and tapering down to a point. This is called a **conical** root. Fig. 5, thick at the middle and tapering both ways, as in the radish, is called a **fusiform** or **spindle-shaped** root.

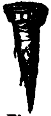


Fig. 4.

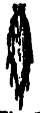


Fig. 5.

The root of the turnip, almost globular, with a short point at the bottom, fig. 6, is called a **napiform** root.

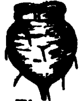


Fig. 6.

When roots of this kind belong to plants that live longer than one year, the lower part of it, only, perishes, and then the root looks as in fig. 7, as in the scabeous.

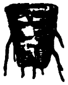


Fig. 7.

§ 3. The second series of forms of roots in Plate I. show the shape of compound roots. In these fibres branch from the body of the root as branches do from the stem. This is best shewn in fig. 8, in the form called **branched**.

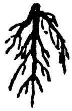


Fig. 8.

When the fibres are small, numerous, and more or less twisted together, they look as in fig. 9, and the root is called **comose** or **hairy**.

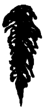


Fig. 9.

The other kinds of compound roots have no distinct stem or tap, but the fibres grow at once from the bottom of the stem or collar.

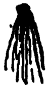


Fig. 10.

If the fibres are simple, so that the root consists of a bunch of straight fibres, we have the kind of root called **simply fibrous**, fig. 10.

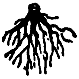


Fig. 11.

But when the fibres branch again into smaller ones we have the **branched fibrous** root, fig. 11.

Just as simple roots, that is, roots of only one fibre, sometimes swell into fleshy bodies called **taps**, so in compound roots, that is, roots having many fibres, some of these fibres swell into fleshy bodies, which are called **tubers**, as shewn in figs. 12, 13, 14, 15, 16. The difference between a tap and a tuber is that a tap is the whole substance of a root, while a tuber is a swollen portion of one of many fibres belonging to the same root.

The simplest form of tuber is shewn in fig. 12, in which the fibres are seen to have, in some parts, swollen into small globular bodies; but sometimes, as in the orchis, fig. 13, the whole length of some of the fibres is swollen in this manner into **ovate** bodies of nutriment.

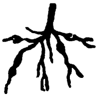


Fig. 12.

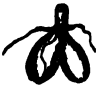


Fig. 13.

These tubers, formed by entire fibres, are sometimes of the shape shewn in fig. 14, when they are called **palmate**, or **hand-shaped**; and sometimes as in fig. 15, when they are called **digitate**, or **finger-shaped**.

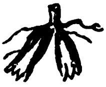


Fig. 14.

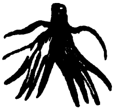


Fig. 15.

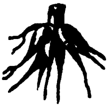


Fig. 16.

In the dahlia, many of the fibres are thus swollen, so that the roots become a bundle of tubers, when it is called **fascicled**, or **bundled**, fig. 16; or **grumose**, meaning **heaped**.

Besides these swellings of the fibres themselves, which serve for nourishment of the plant, there are sometimes little bladders filled with air attached to the roots of plants growing under water, fig. 17, and also little fleshy or woody knobs on the fibres of some other plants, fig. 18.

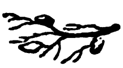


Fig. 17.

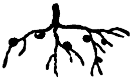


Fig. 18.

§ 4. Some kinds of stems grow underground, and have the appearance of roots, for which they are frequently mistaken. The chief varieties of this kind of stem are shewn in Plate I., under the name of **rootstocks, or rhizomata.** They are not true roots; they grow by addition to the upper end, while a root increases at the lower; also they throw out **leaf-buds**, which roots never do. The real roots of plants having this kind of stem are the small fibres growing from the under surface of the rootstock or stem.

Sometimes this kind of stem runs along the ground, throwing up leaves and stems at the joints, having a bunch of fibrous root at the lower side of each joint, as in fig. 19. This is called a **creeping stem, or root-stalk**.

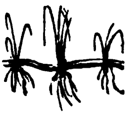


Fig. 19.

In fig. 20 is shewn the same kind of root, changing its direction at every joint, havings till the true roots in small bunches at the joints. A stem or root-stalk, so bending is said to be **kneed**, or having knees.

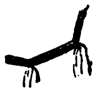


Fig. 20.

Just as the simple roots sometimes become soft and fleshy taps, and as the compound roots form, amongst their fibres, tuberous swellings, so in the root-stalks the underground stem becomes soft and fleshy, serving as reservoirs of nourishment for the stem and leaves. Figs. 21 and 22 shew two forms of this kind, the **contorted**, or **twisted**; and the **sagittate, or arrow-headed.**

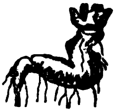


Fig. 21.

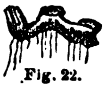


Fig. 22.

Fig. 23 shews the rootstalk, or **rhizoma**, of a primrose, where there is no other stem but this underground one, from which the leaves grow direct. Each little piece, or tooth, of the root-stalk is the hardened remainder of a dead leaf. In fig. 24 the leaves are more perfect. Fig. 23 represents a dentate, or **toothed**; fig. 24 a **squamose**, or **scaly root-stalk.**

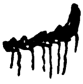


Fig. 23.

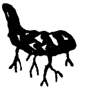


Fig. 24.

Thus we have simple and compound roots; and underground stems, which look like roots, but are not so. The real roots are fine fibres having small holes at the end through which the food is drawn up, but these fibres frequently swell into fleshy bodies, or reservoirs of food for the plant when young. The simple roots are then called **taps**, the compound ones **tubers.**

§ 5. A root can always be distinguished from an underground stem by many signs. A stem throws out branches by means of **buds**, that is a branch comes first, in the form of a bud, on the stem, and gradually extends from a bud to a branch. The root-branches, on the contrary, do not first appear as buds, but grow at once as fibres or branches from the root.

A stem also has **leaves**; a root has none. **Scales** and **stomates** (or little **pores**) appear on most stems, but scarcely ever on roots.

The food enters the root only by the **spongioles**, or small holes at the end of the **root-fibres**, or **branches.** Entering by the spongioles, which are always the newest and most tender parts of the root, the food, always in a fluid state, passes along the branches or pipes of the root until it reaches the main body of the root, from which it is passed on to the stem.

These root-branches are long or short, just as required for the fixing and feeding of the plant. In a large tree the roots spread out wider than the branches, so as to prevent its being blown down by the wind, and also that they may reach beyond the ground shaded by the boughs of the tree, since this ground is too dry and hard to yield much nourishment.

If some of the root-branches be destroyed, the plant will throw out fresh ones, but, if there be not sufficient left to feed the plant while these fresh branches of the root are forming, the plant will die.

Some plants, for instance the mistletoe, have no real roots, but live upon other plants, as the mistletoe does upon the oak. Such plants are called **parasites**, and have small **suckers** instead of roots. They wind their stems round a tree, fixing their suckers in the soft parts of the stem, so as to draw from thence their food.

From the **seed** of a plant spring a root and a stem; the stem bears leaves, flowers, and fruit; the fruit contains seeds from which fresh plants grow. These parts —root, stem, leaves, flowers, and fruit — constitute a perfect plant. Each of these parts has its distinct work to do for the good of the entire plant.

The root descending into the ground fixes the plant to one place, and provides food for it. This food is found in the earth and is drawn up by the root into the body of the plant, or stem; from the stem it is sent to the leaves; the leaves divide the food brought up by the root into what is fit for the plant, and what is of no use.

That which is good for the plant is sent down from the leaves into the body of it to form **wood**, **bark**, &c.; while that which was taken up by the root, but is not wanted, is sent out into the air through small holes in the **leaves**.

The root is, therefore, the feeding apparatus of the plant. It is a continuation of the stem entering the ground, where it divides into branches, just as the stem itself does: with this difference, that the stem bears branches at regular intervals and on every side, while a **root-branch** springs from any point in the root where one may be wanted.

Sometimes these root-branches divide again, but however many branches there may be, they are all hollow, having the end open, so that each branch is, in reality, a pipe, up which food can be drawn from the earth into the body of the root.

In many plants the root not only draws up food from the earth for the present wants of the plant, but it draws up more than is required, storing up the extra quantity against the time of flowering, when the plant requires an extra supply of nourishment.

This is the object of the formation of **tap roots, bulbs, tubers,** &c. These taps, bulbs, tubers, &c., are fleshy reservoirs of food, stored up for the use of the plant at the time of flowering and ripening the fruit, when more nourishment is required than at earlier stages.

THE STEM.

§ 6. The root-stalk, or **rhizoma,** is an intermediate form between the true root and the upright stem. The root-stalk, or underground stem, has the outward appearance of a root, but has also the inward structure, and does the work, of a stem. The different kinds of roots have been already described, as also the intermediate form of rhizomas, and this leads to the upright stem, growing up from the ground and bearing branches, leaves, flowers, and fruit.

The stem of a plant begins as a very small leaf, growing upwards from the seed (while the root begins as a very small leaf growing downwards). The upright small leaf, called the **plumule,** developes according to the kind of seed into a **root-stalk,** a **rush,** a **straw,** a **stipes,** or a **trunk.** These different kinds of stems are shewn in Plate II.

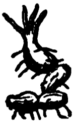


Fig. 25.

Fig. 25, a **rootstalk,** is given again because it belongs to the divisions of stems, though, from its position underground, it is also classed with the roots. It has been already described.

PLATE II.—FORMS OF STEMS.

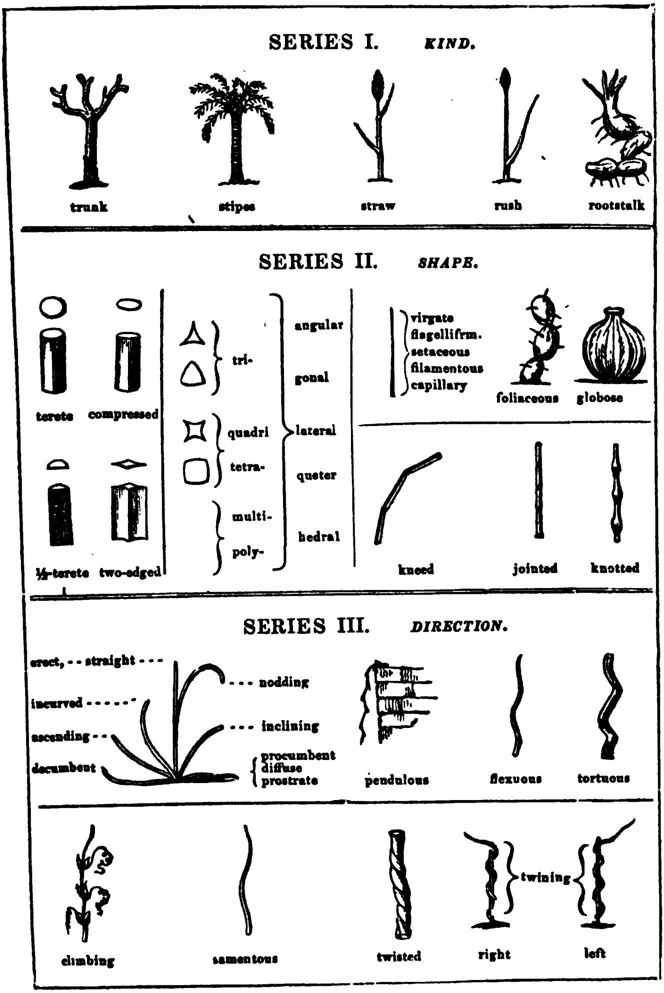


Fig. 26.

Fig. 26 shews the **rush**, having a straight stem, without joints, but with sharp edges, and being filled with soft tissue. Of this kind are rushes, sedges, flags, all growing by the water-side, or in marshes.

Fig. 27.

Fig. 27 is the **straw**, a straight, round, hollow stem, with joints. Of this kind are grasses; corns, as wheat, barley, rye, canes, &c. These very slight stems are strengthened by being covered with a very fine coating of flint.

Fig. 28.

Fig. 28 represents a **stipes**, or stem of a kind of tree that grows erect, of the same thickness throughout, with no branches, being crowned by a number of very large leaves. Of this kind are the cocoa-nut and date trees.

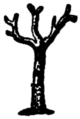


Fig. 29.

Fig. 29 shews a **trunk**, the most fully developed form of stem. From this upright stem spring branches, spreading in every direction. These branches bear leaves, and afterwards, flowers, and fruit. Of this kind are almost all English trees — as the oak, beech, chestnut, &c.

These five forms—**rootstalk**, **rush**, **straw**, **stipes**, and **trunk**—shew the chief varieties of stems. Some plants appear to have none; as, for instance, the primrose and tulip. As has been already explained, this is because the stem is an underground one, or **rhizoma**, which is generally mistaken for the root. Every plant has, necessarily, a stem, but it may be in appearance more like some other part of a plant; or it may be so small, or so undeveloped as to be scarcely observable.

§ 7. Stems are of different kinds, as has just been shewn, the chief varieties being the root-stalk, the rush, the straw, the stipes, and the trunk. But besides this difference of kind, there is a difference in shape, as for example, between the straw, which is round, and the rush, which has sharp edges.

Plate II., Series II, shews the chief varieties of shape in stems.

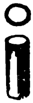


Fig. 30.

The most usual shape is round, the lower end being generally thicker than any other part. These round stems generally diminish very gradually in thickness from the bottom to the top. This kind of stem is said to be **terete.**

Sometimes one side is flat and the other round, as in fig. 31. This is called **half-terete,** sometimes written ½ terete, as in Plate II. When the stem, instead of being quite round, is oval-shaped, as in fig. 32, it is said to be **compressed.**

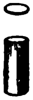


Fig. 31.

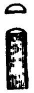


Fig. 32.

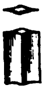


Fig. 33.

The fourth chief variety has four edges, all sharp, but one pair sharper than the other. This is called a **two-edged stem,** fig. 33.

In Plate II., besides the four figures of the stem shapes, there are four sections or cross-cuttings, shewing the appearance in shape of the different kinds of stems when cut across.

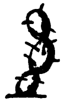


Fig. 34.

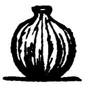


Fig. 35.

Besides these regular shapes there are many irregular, which occur only occasionally, as in the cactus tribe, fig. 34, in which the stem is formed by the flattened, round plates shewn. Other stems are found of the shape given in fig. 35.

Fig. 36.

Fig. 36 shews a stem tapering towards the upper end. When this kind of stem, always very thin, is straight and stiff, it is called **virgate,** or a **rod;** if it is long and flexible it is called **flagelliform,** or a **whip;** if stiff and very slender it is a **seta,** or **bristle;** if slender and flexible it is a **filum,** or **thread;** if very small in diameter it is called **capillary,** or **hair-like.**

Sometimes a stem has joints or knots, as in a cane. If the pointed stem is straight it is called **jointed**, fig. 37; if bent, as in fig. 38, it is called **kneed**.

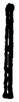


Fig. 37.

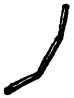


Fig. 38.

If the joints swell, as in fig. 39, the jointed stem is said to be **knotted**, as in some species of cane.

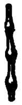


Fig. 39.

§ 8. The different kinds of stems and their different shapes have been described, but there is still another difference, that of the direction in which the stem grows. It may grow erect, or may creep along the ground, or may go in any direction between these two.

Fig. 40 shows the different directions in which stems grow, with the terms applied to each. The erect stem is in the middle, those on the right curve towards the earth, while those on the left curve upwards.

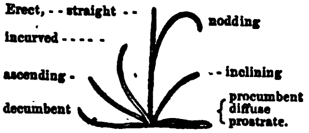


Fig. 40.

Weak stems creep along the ground, as in fig. 40. But if these stems come to the edge of a wall, or of a pit, as in fig. 41, they hang down and are said to be **pendulous**, or **hanging**.

Fig. 41.

Fig. 42 shews a stem bent in regular curves; while fig. 43 shews one bending abruptly. One is called **flexuous**, the other **tortuous**.

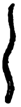


Fig. 42.

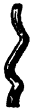


Fig. 43.

Other weak plants support themselves by climbing and clinging to walls, trees, &c. Fig. 44 shews the ten-

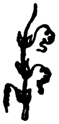


Fig. 44.

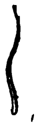


Fig. 45.

drils which such plants wind round the object they fasten themselves to, and fig. 45 shews a **sarment**, or **flexuous stem,** which some climbing plants thrust through bushes or branches to support themselves by.

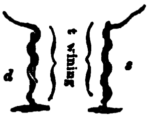


Fig. 46.

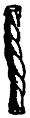


Fig. 47.

Twining **stems** are shewn in fig. 46, where some wind to the right and some to the left. In fig. 47 is shewn a **contorted stem,** twisted as it were round itself.

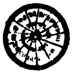
Such are the chief kinds, shapes, and directions of stems; all, however, forming the bodies of the plants they belong to, and all, more or less, bearing leaves, flowers, and fruits.

§ 9. The stem serves to bear the leaves and flowers of a plant, also to convey the food of the plant from the root to the leaves and flowers: besides this, it serves in some plants to store up wood.

Stems are of two kinds: one kind increases by having fresh material added to the outside of the stem, making it thicker; while the other kind has the fresh material added to the inside of the stem, making it, not thicker, but more compact and hard, from the materials being packed more closely together.

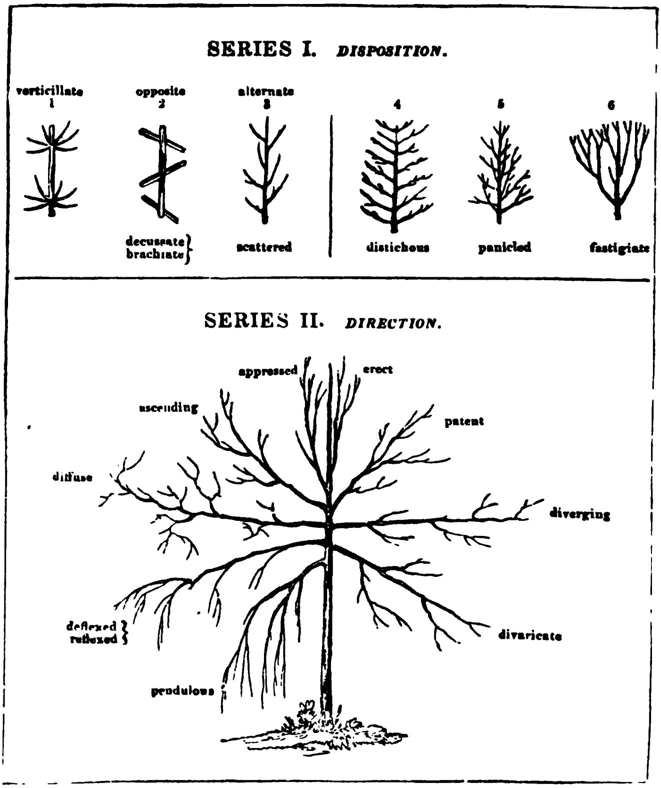
The stem which increases in thickness by the fresh material being laid on the outside is called an **exogen** stem; while the stem which does not increase in thickness, but becomes harder by the addition of fresh material inside, is called an **endogen** stem.

It will be shewn, further on, that the leaves, flowers, fruits, and seeds of an **exogen** stem differ very much in many things from the leaves, flowers, fruits, and seeds of an **endogen** stem. All real stems are either **exogen** or **endogen.**



The figure at the side shews a section of an **exogen stem.** It has somewhat the appearance of a wheel made of one material, and having

PLATE III.—THE BRANCHES.

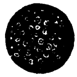


the spaces between the spokes of the wheel filled up with another material.

The centre of the wheel is the **pith**, the outer part is the **bark**, the spokes of the wheel are the **medullary rays**, all of one kind of material. The pieces between the spokes of the wheel are **wood**, and other kind of material. These words pith, bark, medullary rays, and wood will be explained farther on.

The centre, spokes, and outer rim, that is, the pith, medullary rays, and bark, are made of a material called **cellular tissue**, which is spongy, while the wedges of wood are made of a material called **vascular tissue**, which is long and stringy.

The figure at the side shews a section of an **endogen** stem. Here the wedges of wood are embedded in the spongy pith, but not in regular wedges, as in the **exogen** stem. On the contrary, the wood is in bundles of long stringy pieces, growing in any part of the stem.



This difference of the woody fibre being laid in regular wedges, as in the **exogen**, or in an irregular manner, as in the **endogen**, is a very important one, being the chief distinguishing mark by which all stems are divided into the two great classes of **exogens** and **endogens**.

These two classes, as has been already mentioned, are different, not only in the character of the stem, but also in the leaves, flowers, and fruits, and in the way of growing. All plants that bear flowers are divided into these two great classes, **exogens** and **endogens**.

BRANCHES.

§ 10. The branches of a plant are, properly speaking, subdivisions of the stem, from which, in different plants, they grow in different directions and in different manners. Plate III. shews the chief varieties of direction and disposition. The lower diagram shews the various directions in which branches spring from the main stem; some almost erect, others more or less horizontal, others, again, hanging almost to the ground, as in the willow.

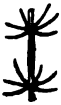


Fig. 46.

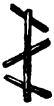


Fig. 47.

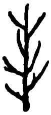


Fig. 48.

The upper diagrams represent the different ways in which the successive branches are disposed round the stem. Fig. 46 shews the branches growing like spokes of a wheel round the stem as an axletree at intervals along it. These are said to be **verticillate.** Sometimes, as in fig. 47, the branches grow in pairs along the stem, and sometimes, as in fig. 48, no two grow together, each new branch being a little higher than the previous one. These two dispositions are called respectively **opposite** and **alternate.**

LEAVES.

§ 11. Leaves are arranged and classified, firstly, according to the shape of their termination, and secondly, according to the kind of margin or edge.

Plate IV. shews the varieties of form in two series; firstly, as to the general shape of leaves that are solid in form; and secondly, the shape of those that are flat, as is more generally the case.

In the solid form of leaves we have some almost a sphere, as in fig. 49, some shaped as a spindle, fig. 50, some like a stick, fig. 51, called **cylindrical,** or if they are very long and thin, they are said to be **filiform,** or **threadlike,** fig. 52; or, again, if tapering to a point, **awl-shaped.**

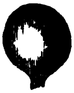


Fig. 49.

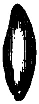


Fig. 50

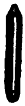


Fig. 51.

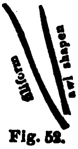


Fig. 52.

Other solid leaves have the form of an egg, fig. 53; others that of a boat-keel, fig. 54; others globular, with a nipple, are called **mamillary,** or **breast-like.**

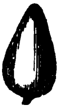


Fig. 53.

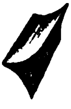


Fig. 54.

PLATE IV.—FORMS OF STEMS.

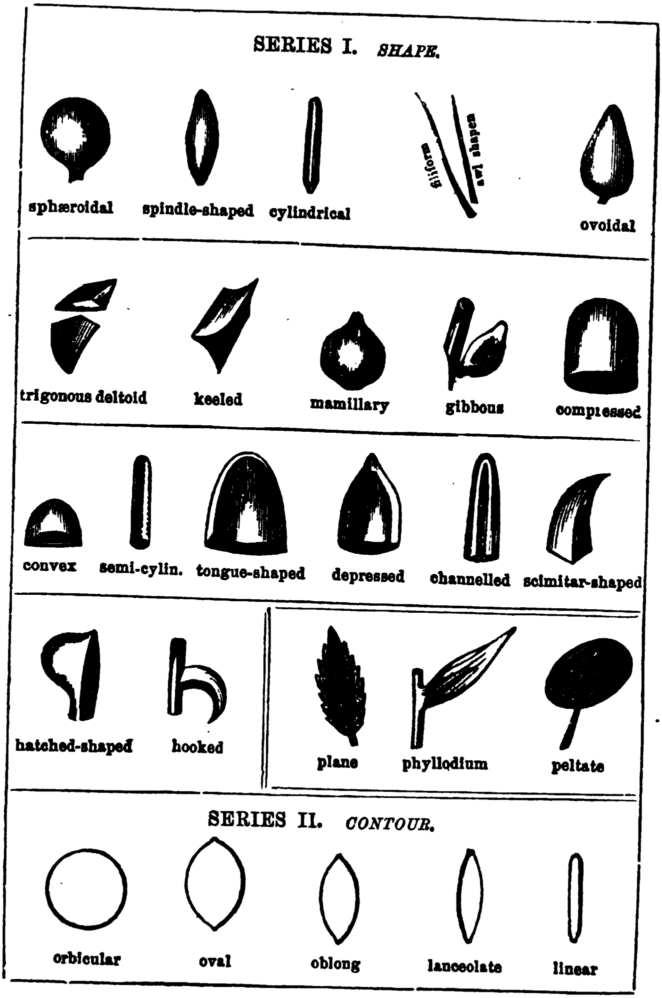
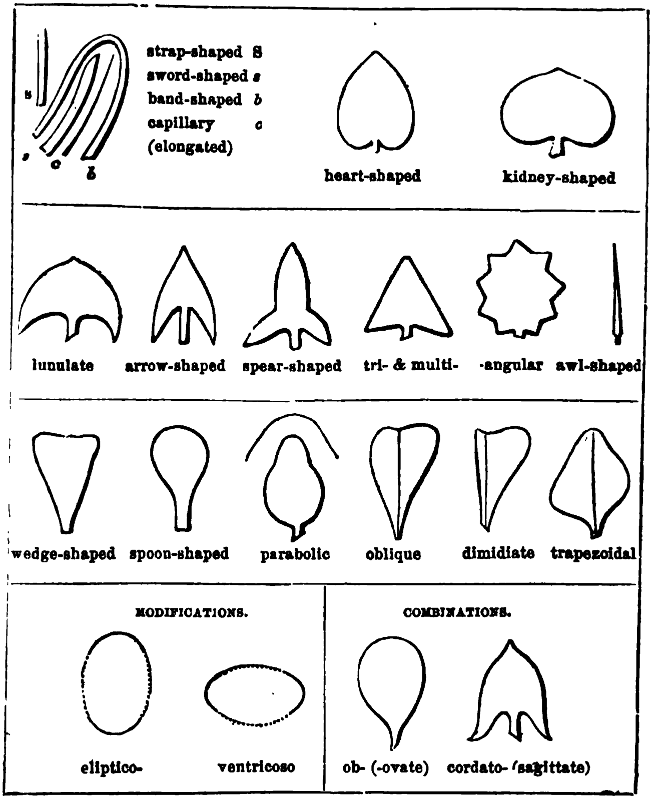


PLATE IV.—*continued.*



Figs. 55 to 64 show ten other varieties of solid leaves, the names of which will be found in Plate III.

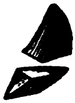


Fig. 55.

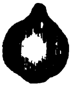


Fig. 56.

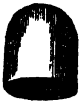


Fig. 57.

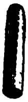


Fig. 58.

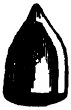


Fig. 59.

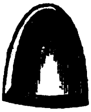


Fig. 60.

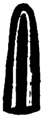


Fig. 61.

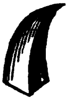


Fig. 62.

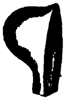


Fig. 63.

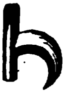


Fig. 64.

Fig. 65 shews the more general kind of leaf, having length and breadth, but not much thickness, of which kind fig. 66 shews an imperfect specimen called a **phyllodium**, or resemblance to a leaf.

Fig. 65.

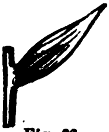


Fig. 66.

In fig. 67 we have a leaf in which the stalk or petiole comes from the middle, so that the leaf forms a kind of shield. This form is called the **peltate**, or **shield-shaped**.

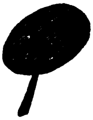


Fig. 67.

§ 12. Series II. in Plate IV. shews the varieties of contour, or outline, in flat leaves. Fig. 68 shews a leaf quite circular, while fig. 72 shews one long and narrow. Figs. 69, 70, and 71 shew three varieties between these two.

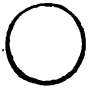


Fig. 68.

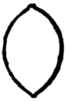


Fig. 69.

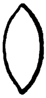


Fig. 70.

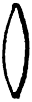


Fig. 71.

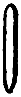


Fig. 72.

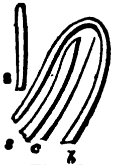


Fig. 73.

These long and narrow leaves, fig. 72, are called **linear**, from their resemblance to a line, and of these there are several varieties, as shewn in fig. 73. s is called **strap-shaped**, *b* **band-shaped**, *s* **sword-shaped**, and *c* **capillary**, or **hair-shaped**.

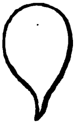


Fig. 74.

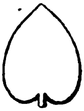


Fig. 75.

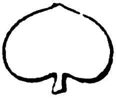


Fig. 76.

Fig. 74 shews an **egg-shaped** leaf; fig. 75 a **heart-shaped**, and fig. 76 a **kidney-shaped** leaf. These three are varieties of the **oval** form.

In the next four shapes of leaves the base widens and recurves so as to form points. Fig. 77 shows a **crescent-shaped**. Fig. 78 an **arrow-shaped**. Fig. 79 a **spear-shaped**, and fig. 80 a **triangular** leaf.

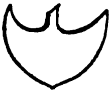


Fig. 77.

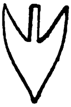


Fig. 78.

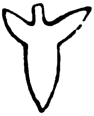


Fig. 79.

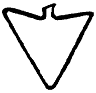


Fig. 80.

This last form, fig. 80, is called **triangular**, because it has three points or angles. Such a leaf as shewn in fig. 81, is called, from a similar reason, **multi-angular**, or **many-angled**. Fig. 82 shews an **awl-shaped** leaf.

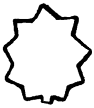


Fig. 81.

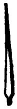


Fig. 82.

All these forms of leaf have the base or lower part wider than the apex or upper part. In the three next forms, however, this is reversed, the upper part of the leaf spreading wider than the base. Fig. 83 shews a **wedge-**

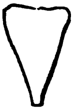


Fig. 83.

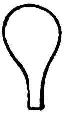


Fig. 84.

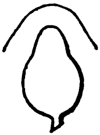
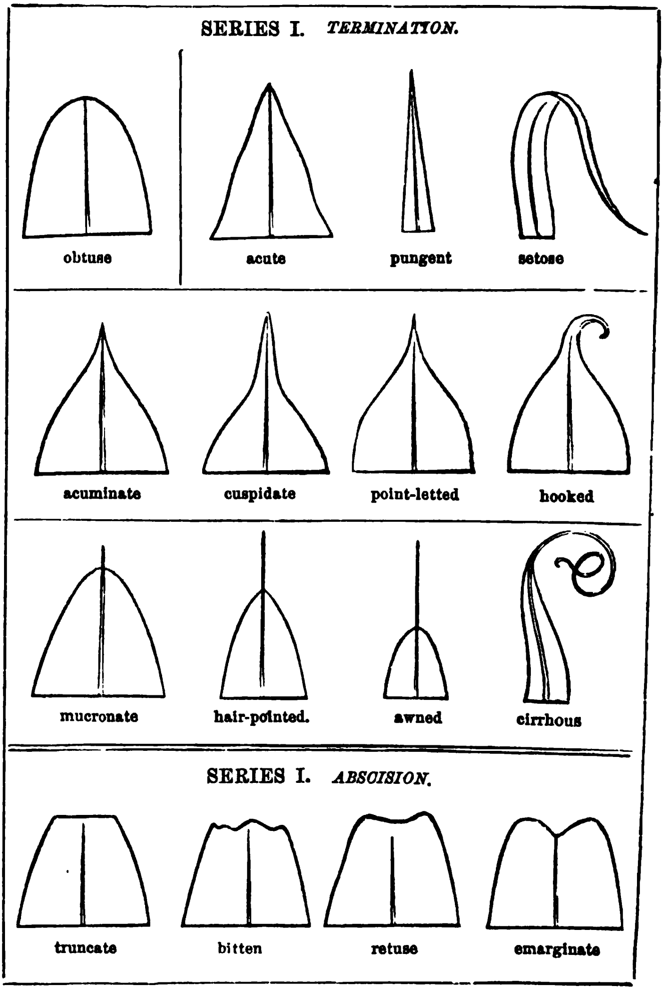


Fig. 85.

PLATE V.—ACUMINATION OF LEAVES.



shaped, fig. 84 a **spoon-shaped,** and fig. 85 a **parabolic** leaf.

All these forms are what is called regular leaves, that is the midrib, or principal vein, divides them into two halves exactly alike, but all leaves are not so, though most are. Figs. 86, 87, and 88 shew three varieties of irregular shapes, called respectively, **oblique,** or **one-sided**; **dimidiate,** or **halved**; and **trapezoidal,** or **four-sided.**

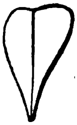


Fig. 86.

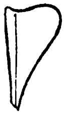


Fig. 87.

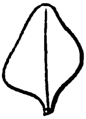


Fig. 88.

§ 13. Leaves are also classified according to their acumination or the manner in which the apex, or part farthest from the base, terminates. Plate V. shews the varieties of this distinction.

In this Plate the upper row of figures, figs. 89, 90, 91, 92, shew four varieties of apex in which the contour of the leaf is **regular.** Fig. 89 is **obtuse,** or **rounded**; fig. 90 **acute,** or **sharp**; fig. 91 **pungent,** or **pointed**; fig. 92 **setose,** or **brittle-shaped.**

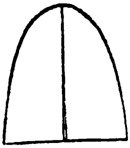


Fig. 89.

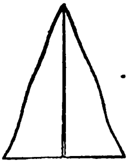


Fig. 90.

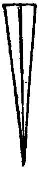


Fig. 91.

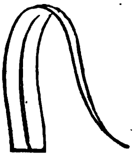


Fig. 92.

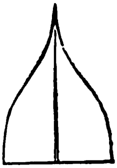


Fig. 93.

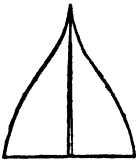


Fig. 94.

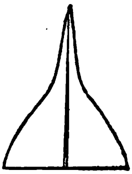


Fig. 95.

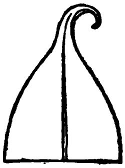


Fig. 96.

The second row of figures in Plate V., figs. 93, 94, 95, 96, show varieties of acumination in leaves where the contour is not regular, that is, the lower part of the leaf has a margin rounding, as though to form an obtuse apex, while the upper part forms a sharp angle. These four acuminations are called respectively, **acuminate-pointed**, fig. 93; **cuspidate-long-pointed**, fig. 94; **pointletted**, or **sharp-pointed**, fig. 95; and **hooked**, fig. 96.

In some leaves the midrib projects beyond the apex. Figs. 97, 98, 99, 100, show four forms of this, called **mucronate**, or **pointed**, fig. 97; **hair-pointed**, fig. 98; **awned**, or **bearded**, fig. 99; and **cirrhous**, or **curled**, fig. 100.

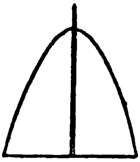


Fig. 97

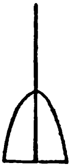


Fig. 98.

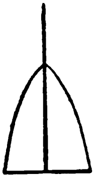


Fig. 99.

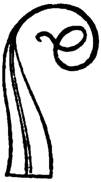


Fig. 100.

The lower series in Plate V. show four varieties of apparently, incomplete forms of leaves, having really no acumination or point. In fig. 101 the leaf is called **truncate**, **or cut**; in fig. 102, the edge being jagged, it is said to be **bitten**. If the apex is recurved, as in fig. 103, it is said to be **retuse**, or **blunted**; and if, as in fig. 104, it is called **enarginate**, **or cut out**.

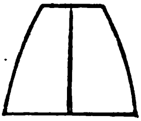


Fig. 101.

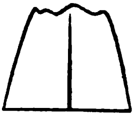


Fig. 102.

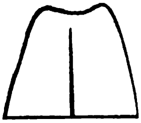


Fig. 103.

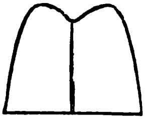
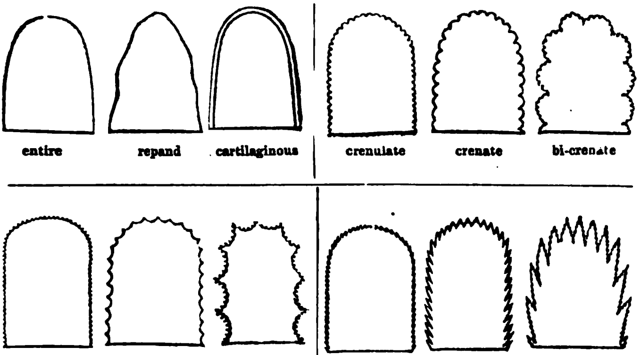


Fig. 104.

§ 14. Leaves are also classified according to the kind of margin or edge, the varieties of which are shewn in Plate VI. Some margins are cut so deeply as to divide the leaf into distinct pieces. while in others the indenta-

PLATE VI.—INCISION OF LEAVES.

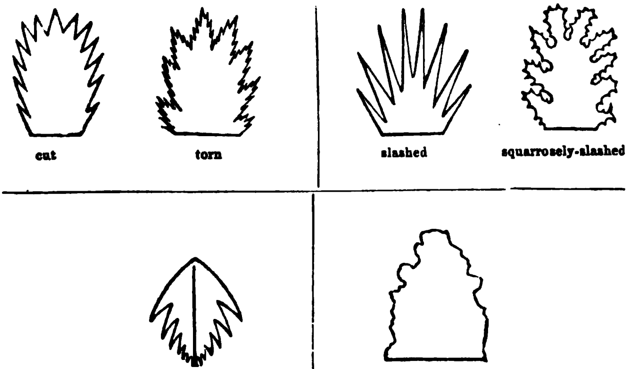
SERIES I. *MARGIN.*



entire repand cartilaginous crenulate crenate bi-crenate

denticulate dentate bi-dentate serrulate serrate bi-serrate

SERIES II. *INDENTATION.*

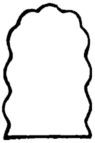


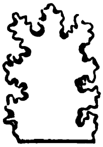
cut torn slashed squarrosely-slashed

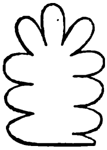
runcinate gnawed

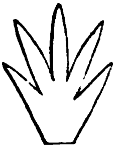
PLATE VI.—*continued.*

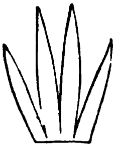
SERIES III. *LOBATION.*

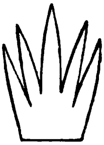

sinuate


curled

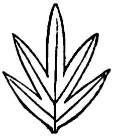

lobed

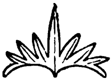

split


parted


divided

(*MODIFICATIONS*)


palmately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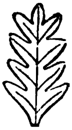
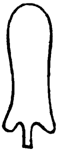
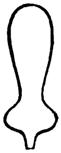
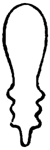
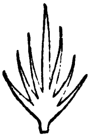
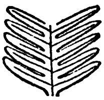

pinnately

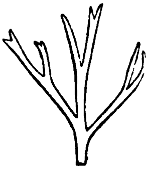

eared

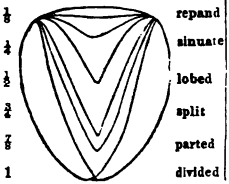

lyre-shaped


fiddle-shaped


digitately


pectinately


dichotomous



tions are so slight as to be scarcely seen, or the edge is altogether smooth.

Plate VI. shews: Series I., where the margin is only slightly indented; Series II., where the leaves are deeply cut; and Series III., where the leaves are almost in separate pieces.

The first divisions, figs. 105, 106, 107, show leaves with edges nearly or quite smooth. Fig. 105 is called **entire**, or **uncut**, fig. 106, **repand**, or **wavy**, and fig. 107, **cartilaginous**, or **gristly**, because the edge is thickened with a gristly border.

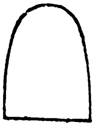


Fig. 105.

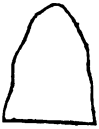


Fig. 106.

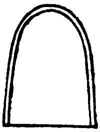


Fig. 107.

When the little projections are round edged, they are called **crenations**. Fig. 108 shows a **crenulate** leaf. Fig. 109, where the projections are larger but still rounded, is a **crenate** leaf, while in fig. 110, where the crenations are large, with their own edges cut, is a **bi-crenate**, or **doubly-crenate** leaf.

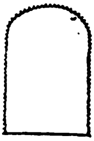


Fig. 108.

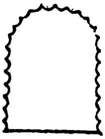


Fig. 109.

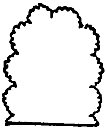


Fig. 110.

But if the projections are sharp instead of rounded, then they are called teeth. This is the crenate kind of edge reversed. Fig. 111 shows a **denticulate**, or **small-toothed** leaf. Fig. 112, where the teeth are large, is a **dentate**, or **toothed** leaf, while in fig. 113, where the teeth are still larger, with smaller teeth on their edge, is a **bidentate**, or **doubly-toothed** leaf.

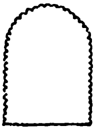


Fig. 111.

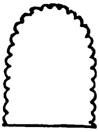


Fig. 112.

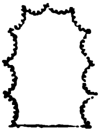


Fig. 113.

If the teeth are very sharp, and all pointing one way,

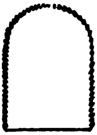


Fig. 114.

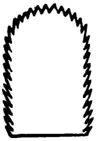


Fig. 115.

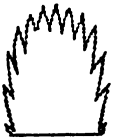


Fig. 116.

the edge is said to be **serrated**, or **saw-like**. In figs. 114, 115, 116, we have respectively **serrulate**, or **small saw-teeth**; **serrate**, or **saw-teeth**; and **bi-serrate**, or **doubly saw-toothed** leaves.

This series, figs. 102 to 113, shew varieties of slightly indented leaves. In the next series the margins are more deeply cut.

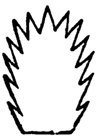


Fig. 117.

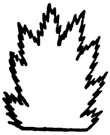


Fig. 118

Fig. 117 shews a leaf with deep cuts in the margin, from which it is called a **cut leaf**. In fig. 118 the whole edge of the leaf is very irregular in outline, as well as being **cut**. This is said to be a **torn leaf**.

In figs. 119 and 120, the leaf is cut very deeply indeed, and is therefore said to be **slashed**. Fig 119 is smoothly cut, but in fig. 120, the edge is very irregular, in addition to being **slashed**, and is therefore said to be **squarrosely slashed**, squarrosely meaning roughly.

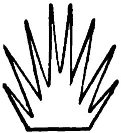


Fig. 119.

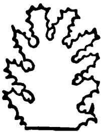


Fig. 120.

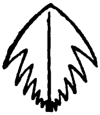


Fig. 121.

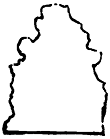


Fig. 122.

Fig 121 shews a leaf cut deeply, but in backward direction. This kind of indentation is termed **druncinate**. While in 122, the edge is extremely irregular, and is said to be **gnawed**, because it looks as though the edge had been eaten into.

In other leaves the projections are wider or more important parts of the entire leaf, than mere teeth or indentations: these projections are then called **lobes or divisions of the entire leaf**. Fig. 123 is a diagram showing the different degrees to which the leaf may be divided, and the different terms used.

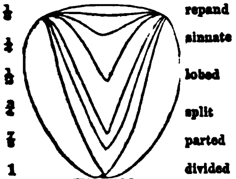


Fig. 123.

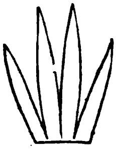


Fig. 124.

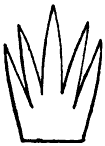


Fig. 125.

If the leaf is divided entirely down to the base, so that the lobes occupy the entire surface of the leaf, it is called a **divided** leaf, fig. 124. If, however, the division extends only near to the base, leaving about one-eighth of the length of the leaf uncut, the leaf is said to be **parted**, as in Fig. 125.

If the leaf is only divided for three-quarters of its length, as in fig. 126, it is called a **split** leaf; and if only half the surface is divided, the divisions, as in fig. 127, are called **lobes**.

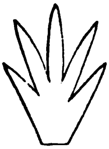


Fig. 126.

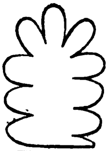


Fig. 127.

If the division do not reach further than a quarter of the width of the leaf, as in fig. 128, the leaf is a **sinuate** leaf, and if not more than one-eighth is divided, the leaf is called **repand**, fig. 106.

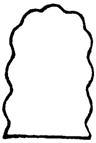


Fig. 128.

When the lobes are themselves crisp, with curled edges, as in fig. 129, the leaf is called a **curled** leaf.

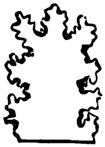


Fig. 129.

All these terms are applied to leaves being divided into many parts, but some few divided leaves have pe-

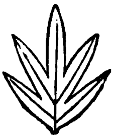


Fig. 130.

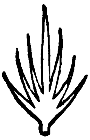


Fig. 131.

culiar shapes, and have therefore special names. Thus a leaf having a form resembling the human hand, that is, with a central palm and lobes resembling fingers, is called a **palmate** leaf, as fig. 130.

But if as in fig. 131, the **fingerlike lobes** are more prominent than the central palm, the leaf is called **digitate** or **fingered.**

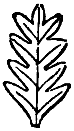


Fig. 132.

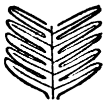


Fig. 133.

Two other forms of lobed leaves, as in figs. 132 and 133, have also special names. The first is called a **pinnate** leaf, from its looking like a feather; the other is a **pectinate** or **comb-like** leaf.

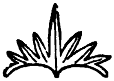


Fig. 134.

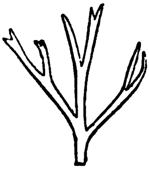


Fig. 135.

In fig. 134 is shewn a leaf, standing as it were on two feet, this is called a **pedate** or **footed** leaf, and in fig. 135 is a leaf much divided, and with each division cut in two. From the twofold division the leaf is said to be **dichotomous** or **cut in two.**

The last specimens of lobed leaves are given in figs. 136, 137, and 138, called respectively **eared,** fig. 136, from the resemblance to the lobes of a human ear; **lyre shaped,** fig. 137, from the resemblance to a lyre; and in fig. 138, is a leaf looking like a fiddle head, and therefore called a **fiddle-shaped** leaf

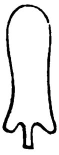


Fig. 136.

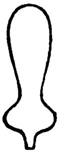


Fig. 137.

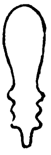
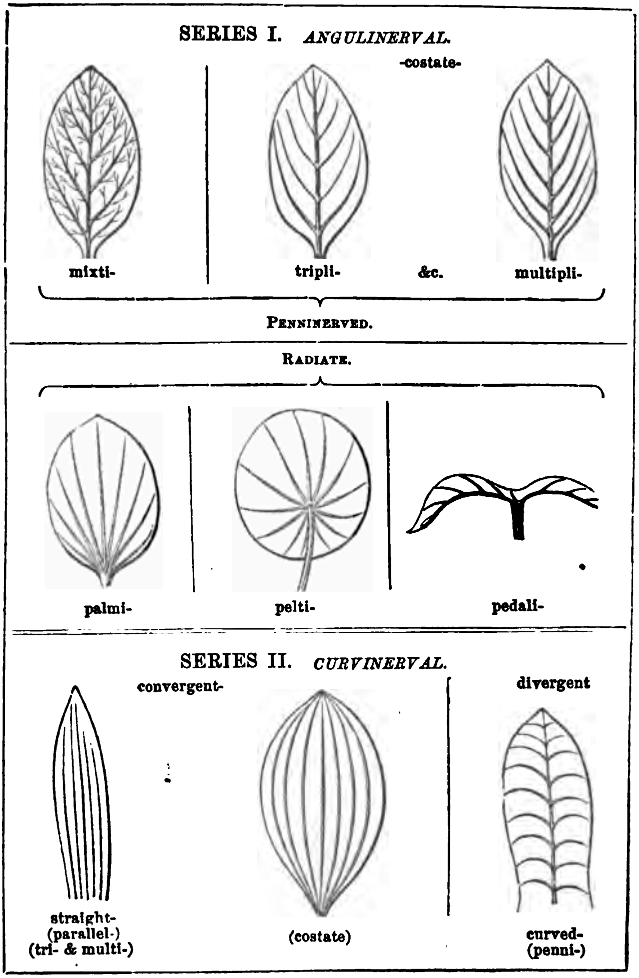


Fig. 138.

§ 15. Through the middle of such leaf runs the **midrib,** fig. 139, which is the continuation of the stalk of the leaf. From this midrib branch off to the right and

PLATE VII.—NERVATION OF LEAVES.



to the left, smaller veins called **primary**, these go nearly to the edge of the leaf, and the leaf curved upwards, each one joining to the next primary vein, as shewn in the figure. These curved ends of the primary veins are called **curved veins.**

Between these primary veins are much smaller ones, running some along the leaf, some across it. These are called some **costal**, and some **proper**, as in the figure.

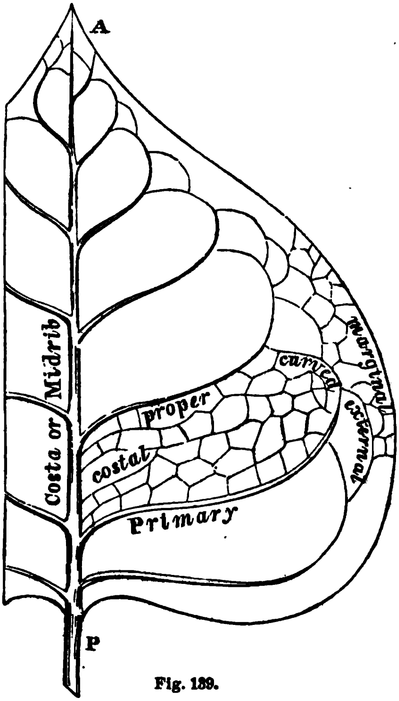


Fig. 189.

Towards the edge of the leaf, and outside the curved veins are other small veins, the ones near the primary veins, are called **external** veins; those at the very edge of the leaf are **marginal** veins.

These nerves in leaves have in different plants, different ways of branching from the chief vein, or **midrib.** Plate VII. shews the chief varieties of **nervation.**

If the primary veins branch off like the branches of a feather, as in the upper series in Plate VII., the leaf is said to be **penninerved** or **feather nerves.** If the primary veins, instead of branching from the **midrib**, spring all together from the end of the leaf stalk, as in the second series of figures, the leaf is said to be **radiate.**

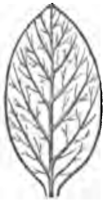


Fig. 141.

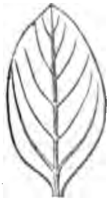


Fig. 142.

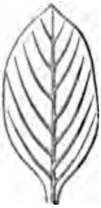


Fig. 143.

Fig. 141, 142, and 143, shew three forms of leaves that are **penninerved** or resemble feathers. Fig. 141 shews a leaf with the primary nerves branching regularly from the midrib, and having smaller veins between, it is therefore called **mixti-nerved,** from the mixture of different veins in it.

Fig. 142 shews a leaf having the two lower primary nerves much larger than the others, so that the midrib and these two primary, are the three chief nerves. The leaf is then said to be **triple-nerved** or **three nerved.**

When, as in fig. 143, many of the primary are larger than the remainder, and as large as the midrib, the leaf is said to be **multi** or **many nerved.**

In the next three figures are shewn leaves with radiate nerves. Fig. 144 is called **palmi-nerved,** from being in the form of a hand; fig. 145 is said to be **pelti-nerved,** from its resemblance to a shield; and fig. 146 is **pedal-nerved,** from its being like a foot.

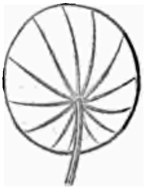


Fig. 144.

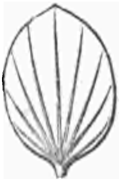


Fig. 145.

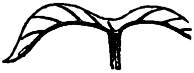


Fig. 146.

PLATE VIII.—COMPOUND LEAVES.

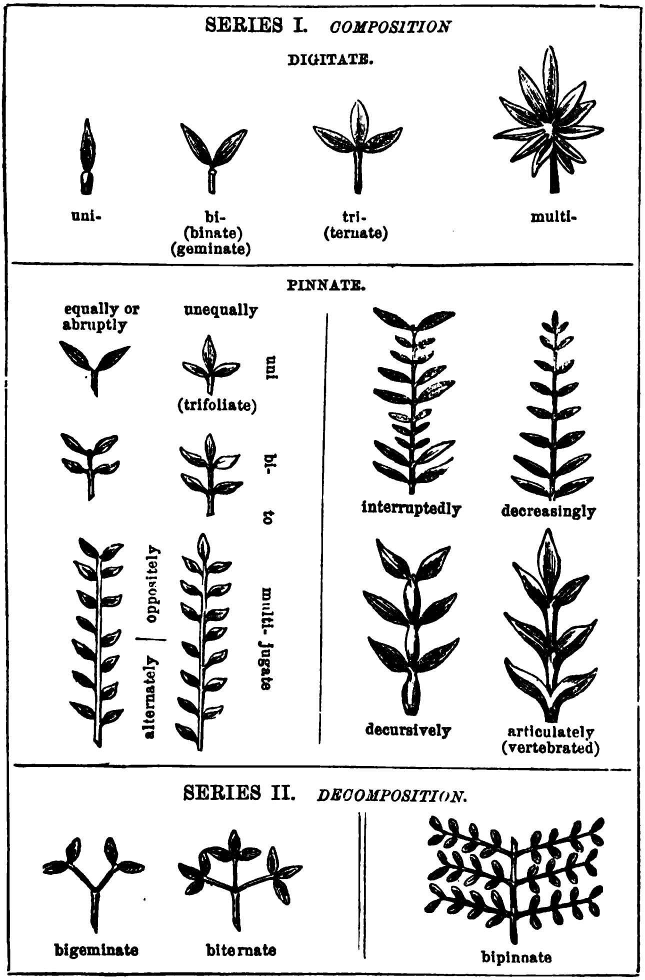
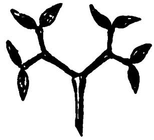
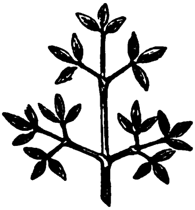


PLATE VIII.—*continued.*

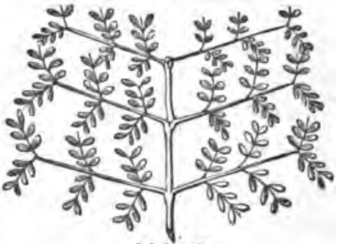
SERIES III. *SUPRA-DECOMPOSITION.*



trigeminate



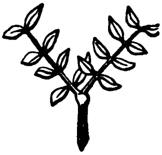
triternate



tripinnate

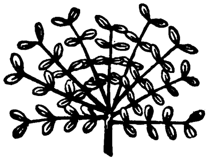
SERIES IV. *COMBINATION.*

DIGITATO-PINNATE



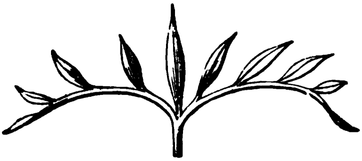
Bi-

to



multi-

PEDATE.



Most leaves have one of these six kinds of nervation; but one great class of leaves have their nervation arranged quite differently from any of those already spoken of.

This kind of nervation is shewn in Plate VII., as **curvinerval.** In these the nerves do not proceed from the chief vein or midrib, but run side by side from the base to the point of the leaf, as in figs. 147 and 148.

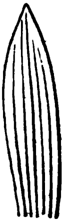


Fig. 147.

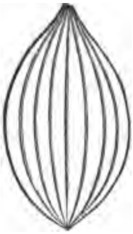


Fig. 148.

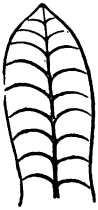


Fig. 149.

In fig. 149 is shewn a leaf of this kind, in which the veins join the midrib part of the distance, branching off from it one after another, at regular distances. This nervation is named **divergent.**

§ 16. All the leaves as yet spoken of are simple leaves; that is, leaves having only one **base, apex,** and **midrib**; but there are other kinds of leaves, which look more like a branch bearing many leaves.

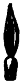


Fig. 150.

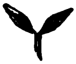


Fig. 151.

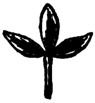


Fig. 152.

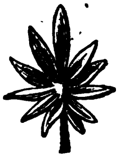


Fig. 153.

Plate VIII. shews a number of **compound** leaves, that is, leaves compounded, or made up, of small leaflets, each looking like a complete leaf. Figs. 150, 151, 152, and 153, shew four of the simplest kind of compound leaves. Each is no more than a single leaf. Fig. 150 has one leaflet, the others have respectively two, three, and four.

The names given to these four forms, are **uni-digitate, bi-digitate, tri-digitate,** and **multi-digitate**; or one, two, three, and many fingered leaves, according to the number of leaflets.

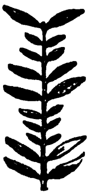


Fig. 154.

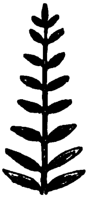


Fig. 155.

The next group in Plate VIII. shews a kind of leaf called **pinnate** or **feather-shaped**, from the shape being similar to that of a feather. In fig. 154, the **leaflets**, or divisions of the leaf, are of different size-placed irregular. This is an **interruptedly-pinnate** leaf.

In fig. 155, the leaflets are of different sizes, but are placed regularly; that is, the largest at the base, the next largest next to them, and so on, the smallest pair being at the point. This is a **decreasingly-pinnate** leaf.

In fig. 156, the leaflets are **sessile**, that is, they have no stalk, but grow at once from the stalk of the leaf, and fold partly round it. This is a **decursively-pinnate** leaf.

Sometimes a leaf of this kind has the stalk jointed at each pair of leaflets, fig. 157, and is then an **articulately-pinnate** leaf. What is here called stalk, is really the **midrib** of the compound leaf, the blade of which is cut up into the leaflets.

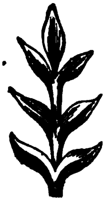


Fig. 156.

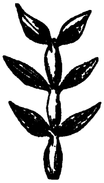


Fig. 157.

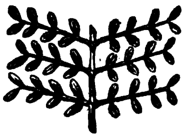


Fig. 158.

Fig. 158, is a **double pinnate** leaf, sometimes called a **bi-pinnate** leaf, **bi** meaning twice or double.

Figs. 159 and 160 shew a double and a treble **digitate** leaf (see figs. 150, 151, 152, 153), but a shorter name is given them in **bi-geminate** and **bi-ternate.**

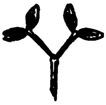


Fig. 159.

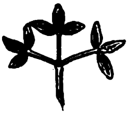


Fig.. 160.

Figs. 161 and 162 shew the **bi-geminate** and **biternate** again divided. These are called respectively **tri-geminate** and **tri-ternate.**

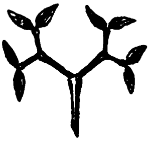


Fig. 161.

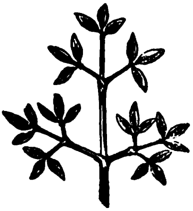


Fig. 162.

Fig. 163 is a **tri-pinnate** leaf, or a leaf of the **bi-pinnate** kind, with the leaflets again divided into smaller ones.

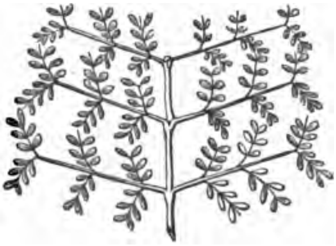


Fig. 163.

Another kind of compound leaf is one having the leaflets arranged on the chief midrib in **digitate** manner, but having the leaflets also divided in **pinnate** fashion. These are called **digitato-pinnate** leaves. These vary from the **bi-digitato**

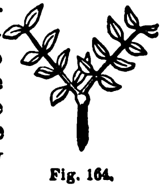


Fig. 164.

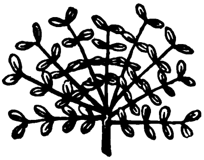


Fig. 165.

pinnate in fig. 164, to the many, or **multi-digitate pinnate** leaf in fig. 165.

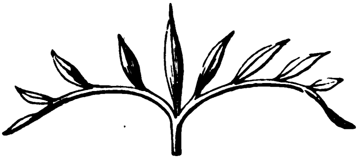


Fig. 166.

Fig. 166 is a **pedate** leaf, from its resemblance to a bird's foot in shape.

Arrangement of Leaves.

§ 17. Plate IX. shews the various ways in which leaves are arranged on the stem, how they have different situations on the stem, are attached to it in different manners, and spread from it in different directions, and also how they are arranged in different ways amongst themselves.

Series I.—The Situation of Leaves on the Stem.

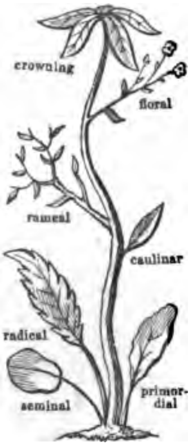
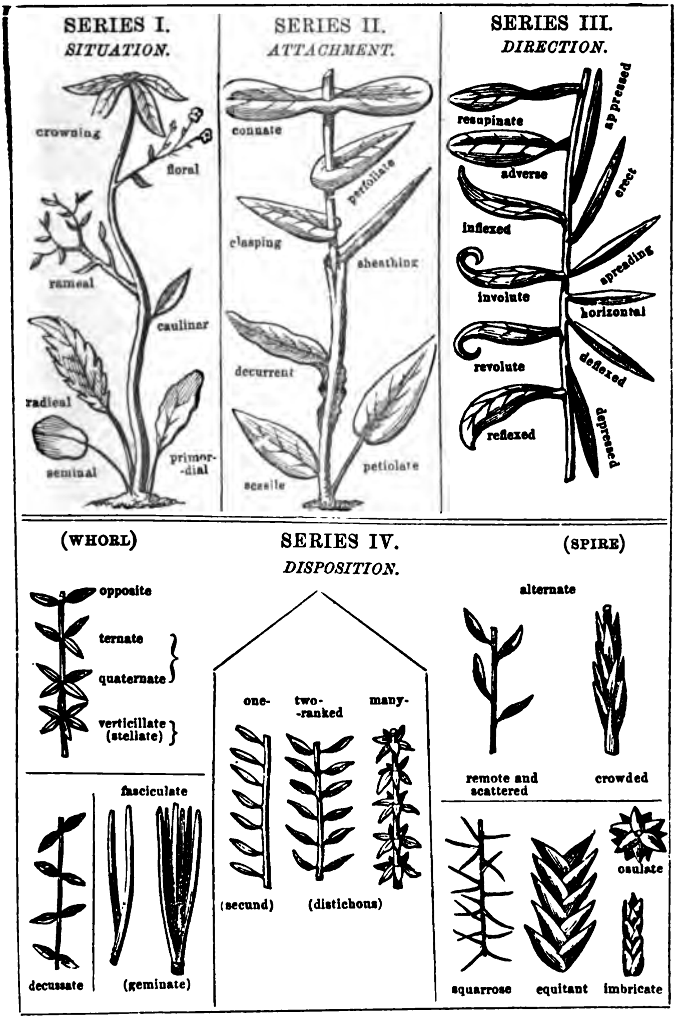


Fig. 167.

Strictly speaking, all leaves spring from the stem, but in some plants the stem is so small as to be scarcely seen. In this case the leaves seem to rise from the root, and are called **radicle** leaves.

In an ordinary stem the first leaf grows from the seed, and is called a **seminal** leaf. The next developed leaf is the **primordial**, or **first** leaf. A leaf growing on the stem itself is a **caulinar**, or **stem** leaf, while one growing on a branch is a **rameal**, or **branch** leaf. Leaves growing on a flower-stalk are **floral**, or flower leaves, and lastly, leaves on the top of the stem are called **crowning** leaves. All these are shown in fig. 167.

PLATE IX.—ARRANGEMENT OF LEAVES.



SERIES II.—THE ATTACHMENT OF THE LEAF.

When the leaf grows at once from the stem without a petiole, or flower-stalk, it is a **sessile** leaf. When the midrid of the leaf is partly joined to the stem it is a **decurrent** leaf. Sometimes the lower part of the leaf closes round the stem, and then it is a **sheathing** leaf, or the base of the leaf extends round the stem without meeting, and it is then a **clasping** leaf. If the stem grows, as it were, through the base of the leaf, it is a **perfoliate** leaf. And lastly, if two **perfoliate** leaves grow together, they are called **connate** leaves. An ordinary kind of leaf, having a **stalk**, or **petiole**, is called a **petiolate** leaf. All these different leaves are shewn in fig. 168.

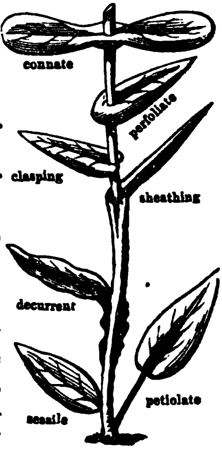


Fig. 168.

§ 18. SERIES III.—DIRECTION OF THE LEAF.

The annexed figure shews the different ways in which leaves spread out from the stem. The leaves on the right side extend straight from the branch, while on the left side are shewn the various ways in which leaves curl up or down on different plants.

The names given to each direction is written under it, so that they need not be given again here, as the meaning of each is evident from the position of the leaf to which it belongs.

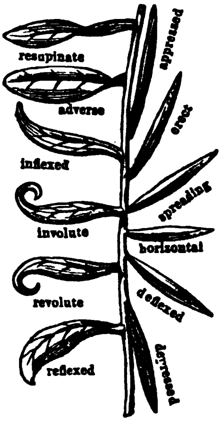


Fig. 169.

§ 19. SERIES IV.—DISPOSITION OF LEAVES ON THE STEM.

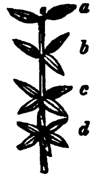


Fig. 170.

When two or more leaves grow together at one part of the stem they are called a **whorl,** fig. 170.

Two leaves together are said to be **opposite** (170*a*); three together are **ternate** (170*b*); four together are **quaternate** (170*c*); more than four together are **verticillate** (170*d*)

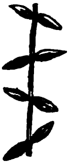


Fig. 171.

Fig. 171 shews leaves in pairs called **opposite,** but not all pointing in the same direction. Each pair of opposite leaves points crossways to the pair above and the pair below it. These leaves are said to be **decussate, or cross-wise.**

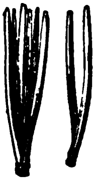


Fig. 172.

Sometimes, as in fir-trees, the leaves are long and thin, and grow in bundles of two or more, fig. 172. If only two they are **geminate**; if more than two, **fasciculate,** or **bundled.**

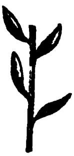


Fig. 173.

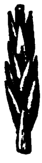


Fig. 174.

When the leaves do not grow together, but each one separate, they are said to be in **spires.** If they grow at different distances, and irregularly, fig. 173, they are **remote,** or **scattered**; but if close together, but still one above another, fig. 174, they are **crowded.**

When the leaves stand out irregularly, branching out in all directions, fig. 175, the disposition is **squarrose.** If, on the contrary, they are close and regular in two rows, and partly covering each other, the disposition is **equitant**, fig. 176. If they are arranged in this way on all sides of the stem, the disposition is **imbricate**, fig. 177. A few imbricate leaves by themselves make a **rosulate** arrangement, fig. 178.

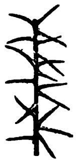


Fig. 175.

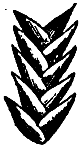


Fig. 176.

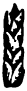


Fig. 177.

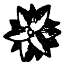


Fig. 178.

Figs. 179, 180, and 181 shew the leaves arranged one, two, or three together

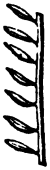


Fig. 179.

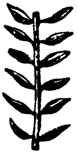


Fig. 180.

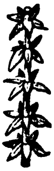


Fig. 181.

§ 20. A leaf serves the same purpose to a plant that the lungs do to a man. A man breathes by means of his lungs; a plant breathes by means of its leaves, and cannot live if they be altogether taken away.

A tree is covered with bark, which surrounds the stem and all the branches. The leaves are really pieces of this bark growing away from the stem. This bark forms the outer portion of each leaf. The pith in the centre of the tree also runs through the branches into the inside of the leaves.

The food drawn from the ground by the roots passes up the stem along the branches into the leaves. In the leaves it is acted on by the air, which enters then by the little holes, called **stomates**, in the skin of the leaf.

This air mixes with the food brought up from the root, changes it into wood, &c., which passes down the branches again, and is deposited in the stem. This is the way in which wood is made.

The leaves of a tree therefore are the means by which a tree **breathes**, by which it **digests** its food, and by which it is **nourished**.

A tree cannot live long if its leaves are all taken off as fast as they grow. If a tree be once stripped of its leaves, it will throw out fresh ones. If these be destroyed as fast as they come, the tree will die for want of air and food.

A tree will also die if its leaves have not both light and air. If there be not enough air, the leaves cannot breathe any more than a man could. If there be not enough light upon the leaves they are not able to digest the food which the roots send up to them.

By **digesting food** is meant to alter the fluids sent up by the roots into what is required for the support of the plant. This alteration is made chiefly by mixing air with the fluids. This is called **digestion**.

A leaf always begins to grow as a small point upon the stem. This point becomes larger, and larger, until it spreads out into a leaf. Leaves are of every variety of shape, but all are alike in being pieces of the bark, having **veins** through which the air is drawn in, and **soft pith** along which the food is sent from the stem, and by which it returns to the stem again, after the leaf has altered it into food fit for the plant.

Frequently two small leaves grow at the base of the leaf just below it, on the stem. These are called **stipules**.

Just as stems are divided into **exogen** and **endogen** stems, so leaves are divided into **exogen** and **endogen** leaves, and just as the two kinds of stems are differently constructed; so are the two kinds of leaves.

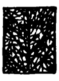


Fig. 182.

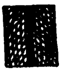
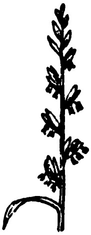


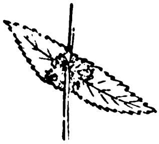
Fig. 183.

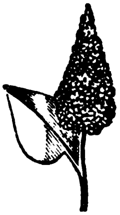
Fig. 182 shows an **exogen** leaf, having, a **mid-rib**, or **middle vein**, with smaller veins branching from it; and smaller again from them; and so on. Fig. 183 shows an **endogen** leaf, having all the veins running, more or less, side by side, from the base of the leaf to the point, and not branching one from another.

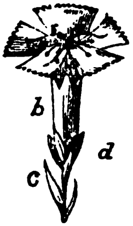
A leaf may generally be said to be either **exogen**

PLATE X.—INFLORESCENCE.

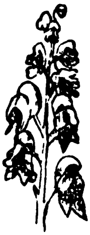

spike, sessile flowers

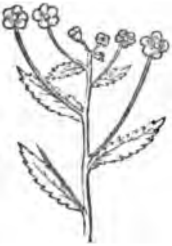

verticillate, round the stalk

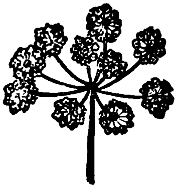

head, a group of flowers, all sessile

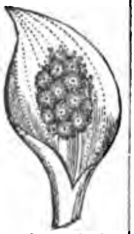


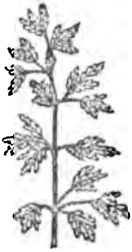
a solitary flower

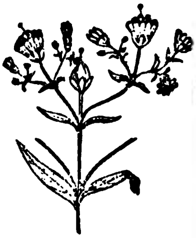

aceme, same as pike, but peduncles to flowers

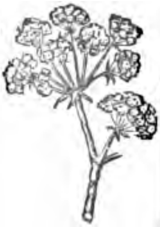

corymb, a raceme, but level at top

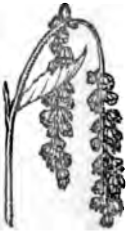

umbel, a head with peduncles to flowers


spadix, a fleshy spike, with involucrum


panicle, a compound raceme


cyme, a panicle flat at top


compound umbel


catkin or amentum

or **endogen** by examining the way in which the veins run through it.

INFLORESCENCE.

§ 21. The manner in which flowers are attached to plants is called **inflorescence.**

The simplest inflorescence of all is where one flower grows by itself at the end of the stem, or, as it is in this case called, the **scape,** as in fig. 184, or when single flowers grow at the end of peduncles growing out from the stem just within the leaf stalk, or as it is called the **axil** of the leaf: this kind of inflorescence is called **solitary.**

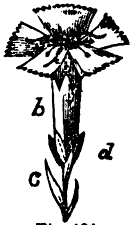


Fig. 184.

Another simple inflorescence is where the flowers grow singly at small distances along the stem, as in fig. 185, without any short flower stalk. This inflorescence is called a **spike.**

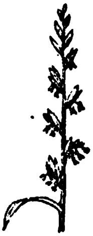


Fig. 185.

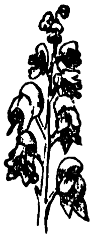


Fig. 186.

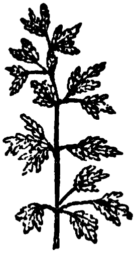


Fig. 187.

If the flowers grow along the stalk, as in a **spike,** but having flower stalks, or **peduncles,** the inflorescence becomes a **raceme,** as in fig. 186.

If a **raceme** has the flowers compound, that is, each peduncle having more flowers than one, each one on smaller peduncles or pedicels, it becomes a **panicle,** as in fig. 187.

If a **raceme** has the peduncles of different length, the shortest at the top, so that the flowers are all at the same level making a flat top, it becomes a **corymb**, as in fig. 188.

If this **corymb** has pedicels upon the peduncles, that is, more flowers than one on each, it becomes a **cyme**, as in fig. 189.

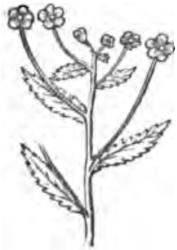


Fig. 188.

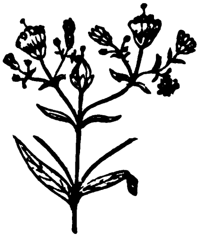


Fig. 189.

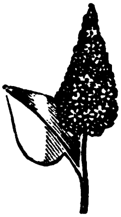


Fig 190.

A cluster of flowers growing thickly together at the end of a stem or branch, without flower stalks, forms a **head**, as in fig. 190.

Flowers upon peduncles, with the peduncles all springing from the same point in the stem, as in fig. 191, form an **umbel**.

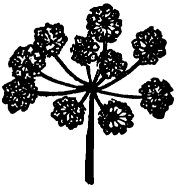


Fig. 191.

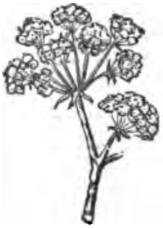


Fig. 192.

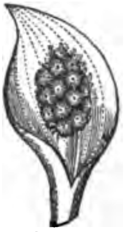


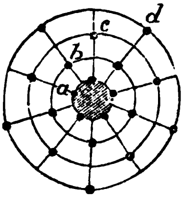
Fig. 193.

The same inflorescence, with each peduncle bearing more flowers than one, on pedicels, as in fig. 192, is a **compound umbel**.

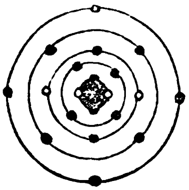
A head of flowers (as in fig. 190) is sometimes enclosed in a large **bract** or **involucrum**, as in fig. 193. This is a **spadix**.

PLATE XI.—PARTS OF THE FLOWERS.

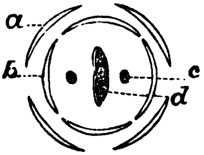
PLAN OF FLOWERS.



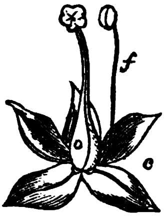
a regular five-part flower



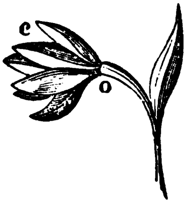
a cruciferous flower



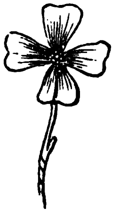
flower of the speedwell



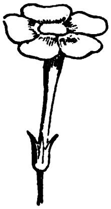
calyx inferior, or below ovary



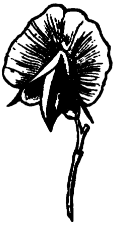
calyx superior, or above ovary



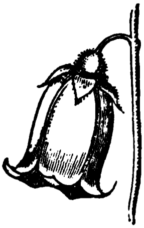
cruciate, or crosswise



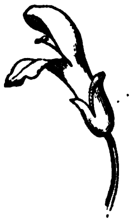
salver-shaped. with long tube.



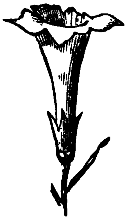
papilionaceous, butterfly-shaped



campanulate, bell-shaped

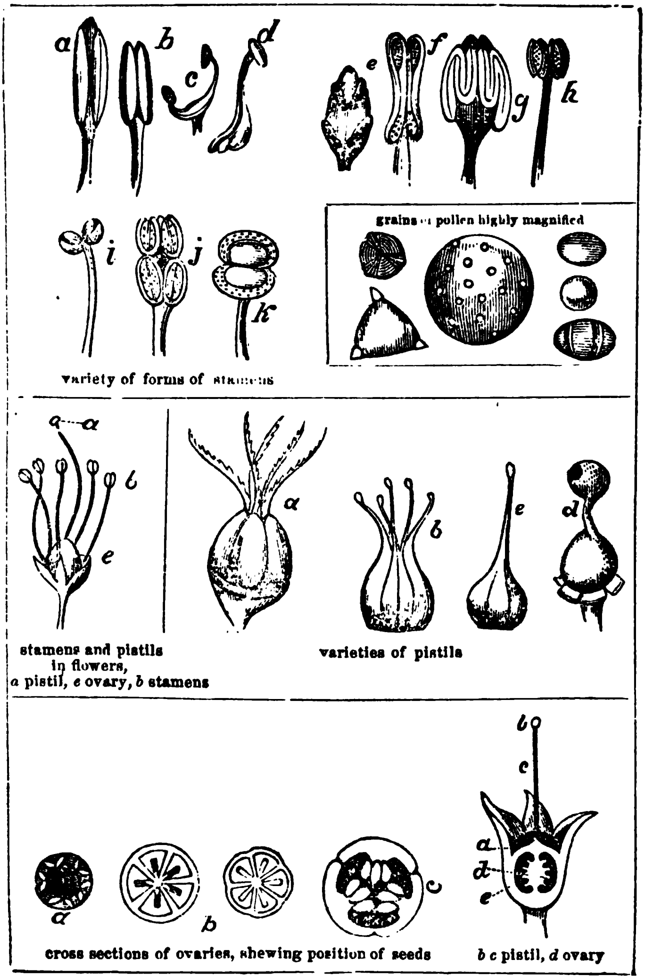


labiate, or lipped



funnel-shaped

PLATE XI.—*continued.*



variety of forms of stamens

grains of pollen highly magnified

stamens and pistils
in flowers,
a pistil, *e* ovary, *b* stamens

varieties of pistils

cross sections of ovaries, shewing position of seeds

b c pistil, *d* ovary

In most timber trees the flowers are in long spikes, with the flowers close together, but the whole spike falls away from the tree when ripe, instead of the flowers singly falling. This is called a **catkin** or **amentum**, as in fig. 194.

Fig. 195 shows flowers grouped on both sides of the stem in the axils of leaves. This is a **verticillate inflorescence**. fig. 195.

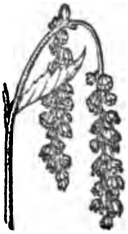


Fig. 194.

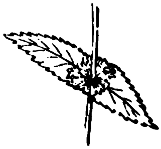


Fig. 195.

Plate X. show these various kind of inflorescence.

PARTS OF A FLOWER.

§ 22. Plate XI show 3 plans of arrangement of the parts of a flower amongst themselves.

The small black dots stand for the **sepals, petals, stamens**, and **pistils**. The circular lines do not show any part of the flower, but only show that the parts of the flower are regularly arranged, generally in circles.

Fig. 196 shows the arrangement of the **sepals, petals, stamens**, and **carpels**, of a regular flower having 5 of each, *a* being the **carpels**, *b* the **stamens**, *c* the **petals**, *d* the **sepals**. The **carpels** join together in the middle of the flower to make the **pistil**: the 5 **stamens** are regularly arranged round the **pistil**, one of the **stamens** being between, and not opposite to, the **carpels**. The 5 **petals** are in a circle round the **stamens**, one between each two, and opposite to one of the **carpels**. Finally the 5 **sepals** are arranged regularly round the **petals**, one between each two, and opposite one of the **stamens**. Thus the **carpels** and the **petals** are opposite to each other, all round the flower, and so also are the **stamens** and **sepals**.

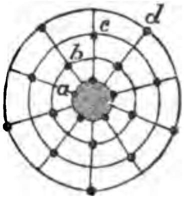


Fig. 196.

This is a regular flower of 5 parts. In a regular flower of 4 parts or 3 parts, the arrangement would be the same, excepting the less number.

In fig. 197 the arrangement is less simple. Here there are 4 **sepals**, 6 **stamens**, 2 **pistils**. The apparent irregularity is caused by there being 2 rows of **stamens**, 8 in all, but 2 of the outer row of **stamens**, and two of the **carpels**, are not fully developed, so that there are only 6 **stamens** instead of 8, and only 2 **carpels** instead of 4. The black dots in the figure show the position of the parts that are present; the black rings, with white centres, show the position of the abortive **stamens** and **carpels**, that is, of the **stamens** and **carpels** that do not grow.

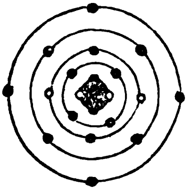


Fig. 197.

Fig. 198 shows a flower with fewer parts, there being only 4 **sepals**, 4 **petals**, 2 **stamens**, and 2 **carpels**. It will be noticed that the **carpels** are still alternate with the **stamens**, and not opposite to them; also that the **sepals** are not opposite to the **petals**, but alternate with them, covering, as it were, the joining of the **petals** with each other.

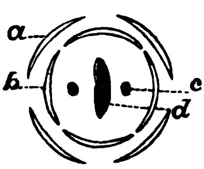


Fig. 198.

THE CALYX.

§ 23. Figs. 199 and 200 shew a very important difference in the way the **calyx** and **ovary** are arranged.

In fig. 199 the **calyx** and **ovary** are quite independent of each other: *o* is the **ovary**: *c* the **sepals**: *f* shews the position of a **stamen**. The **ovary** rises quite freely above the **calyx**; which grows out from beneath it. Here the **ovary** is said to be **superior** (or above), and the **calyx** **inferior** (or below).

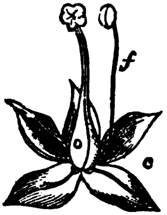


Fig. 199.

In fig. 200 the position of each is **reversed**: the **calyx** *c* grows to the sides of the **ovary** *o*, growing out above it, so that the **ovary** is quite within the **calyx**. Here the **calyx** is said to be **superior** (or above), and the **ovary** to be **inferior** (or below).

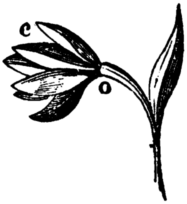


Fig. 200.

There is not so much variety in the form of the **calyx**. It has generally 5, 4, or 3 **sepals**, but occasionally no **sepals** at all, the calyx being only the tube or lower part of an ordinary calyx. The **calyx** of a flower, when present, is generally green, but sometimes coloured gaily like the petal.

THE COROLLA.

§ 24. The **corolla** is generally the gayest part of the flower, but is much oftener absent than the calyx. The petals of a **corolla** is the prettiest and most delicate part of a plant, and generally the first to die, or fall away.

Petals assume a great variety of forms, occasionally looking like crosses, bells, funnels, butterflies, lizards, and even in one instance, bearing a comical resemblance to the form of men.

Fig. 201 is a **cruciate** or **cross-ways corolla**, the petals being arranged in the form of a cross. Fig. 202 is a 5 petal corolla with a long tube below: this is a **salver-shaped corolla**.

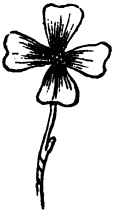


Fig. 201.

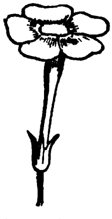


Fig. 202.

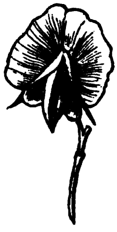


Fig. 203.

Fig. 203 shews a corolla called **papilionaceous**, or

butterfly-shaped: two of the petals rising out like a pair of wings: the whole of the petals being very prettily coloured. Peas, beans, vetches, &c. have all this kind of corolla.

Fig. 204 shews a **companulate** or **bell-shaped corolla**, all the petals being joined at the edge.

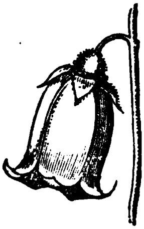


Fig. 204.

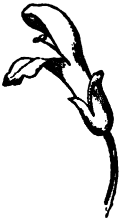


Fig. 205.

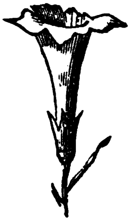


Fig. 206.

Fig. 205, a **corolla** with two lips, a big one and a little one, is called a **labiate corolla.**

Fig. 206 is a **corolla** with the **petals** joined at the edge and looking like a funnel.

These **corollas** with the **petals** joined at the edge are called **monopetalous**, (or **one-petal**) **corollas**: but it must be remembered that they are not made of one petal only, but that the petals are joined at the edges and can easily be separated, often with the slightest touch.

THE STAMENS.

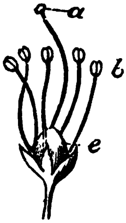


Fig. 207.

§ 25. Fig. 207 shews a flower with the **petals** taken away and the **sepals** very small, so that the arrangement of the **stamens** and **pistil** can easily be seen. The **style** is seen rising from the **ovary** *e*, having the **stigma** *a* at the top, while the 5 **stamens** *b*. are ranged round it.

Fig. 208 shews a variety of **stamens**, shewing the many different forms they assume. *a* and *b* are two ordinary **stamens** with 2 **anthers** seated upon a **filament**: in *c* the two

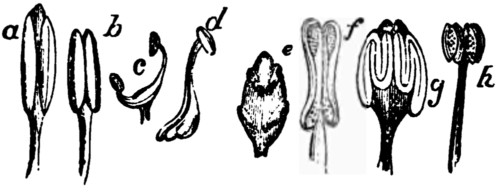
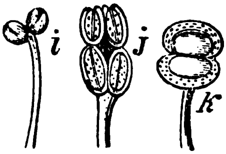


Fig. 208.

anthers are at the ends of a curved **filament**: in *d* one **anther** ends a thick and curved **filament**: *e* shews a short and thick **stamen** with 4 **anthers**: in *f* the two **anthers** are slightly twisted, and in *g* very much so: in *h* there are 4 **anthers** together at the top of a filament, and in *i* two **globular anthers** surmount the **filament**: in *j* 4 **anthers** extend down the **filament**: and in *k* the **anthers** are large and laid crosswise, one above the other.



POLLEN.

§ 26. Fig. 209 shows some varieties of **pollen**, very highly magnified. From this it will be seen that the yellow particles of dust that are scarcely visible to the naked eye, are really very complicatedly and wonderfully made. **Pollen** is of many shapes and sizes, but all have the same office, that of fertilizing the **ovules** of the **pistil**, and causing them to become **seeds**.

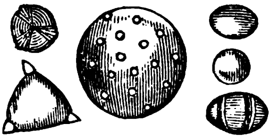


Fig. 209.

THE PISTIL.

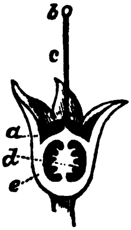


Fig. 210.

§ 27. Fig. 210 is a section of the interior of a **carpel** shewing the position and arrangement of the seed. *c* is the style of the **pistil** rising above the **ovary** *a*, and having at its top the **stigma** *b*; *e* is the **calyx** adhering to the **ovary**. In the middle of the **ovary** is seen a downward continuation of the **style**, to which the seeds are attached. It must however, be carefully borne in mind that all ovaries do not have their seed arranged in this manner, there being many different ways. Fig. 211 shews some of these ways of the seed being attached to the **ovary**. In *a* the seeds are arranged round a **central placenta** (as it is called); in *b* two diagrams of **axil** attachment are shewn, the seed being in the **axils** at the centre. In *c* the attachment is **parietal** or to the sides of the **ovary**.

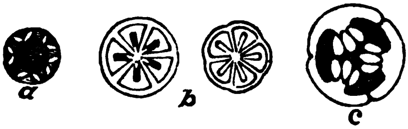


Fig. 211.

Fig. 212 shews 4 **pistils**: *d* is a single **carpel** with short **style** and large **stigma**: *c* is composed of several

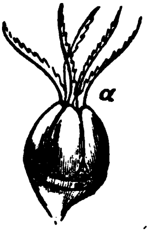


Fig. 212 a.

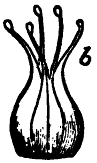


Fig. 212 b.

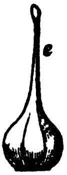


Fig. 212 c.

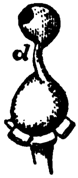


Fig. 212 d.

carpels, having one **style** and **stigma** only: *a* and *b* have 5 **carpels**, each separate, with separate **style** and **stigmas**.

A return glance at fig. 211 will shew that a **pistil** has sometimes one cell and sometimes more.

THE FLOWER.

§ 28. The root, stem, and leaves of a plant are the organs by which the food is brought from the ground, fitted for the nourishment of the plant, and finally deposited in the stem and branches. By means of flowers this nourishing process is carried a step farther. Not only is the living plant kept alive and nourished, but seeds are produced and ripened; which seeds can produce new plants.

So that plants feed themselves by means of their roots, stems, and leaves, and produce fresh plants by means of their flowers. The new plants so produced are always of the same kind as the plants bearing the seeds from which they grow.

In the middle of every flower is the **pistil**, or part containing the seed. This is at first very small, but gets bigger and bigger, until at last it bursts, and the seeds, which are now full grown, and ready to grow, fall out.

In the flower, near the pistil, are the **stamens**. These are generally ranged in a row round the pistil or **seed pod**. These stamens contain very small grains of a substance called **pollen**. These grains the stamens, when they are ripe, pour out upon the top of the pistil, which is called the **stigma**.

The pistil will not ripen and bear seeds without this pollen is poured upon it, and penetrates inside it; but, as soon as the pollen does reach the inside of the pistil, the latter begins to ripen.

The pistil is always in the middle of the flower, having the stamens on each side. Round the stamens is the **floral envelope**, which is sometimes single, sometimes double. The floral envelope is one or more delicate leaves, generally of a gay colour.

If there is only one row of these leaves, it is called the **calyx**; if there are two, the outer one is called the **calyx**, and the inner one the **corolla**.

The flower of a plant is divided into **calyx**, **corolla**, **stamens**, and **pistil**. The calyx and corolla are again divided into **sepals** and **petals**; and the sepals, petals, stamens, and pistils are themselves divided.

The sepals and the petals consist of **limbs** and **claws**, the stamens of **anthers** and **filament**, and the pistil into **stigma**, **style**, and **ovary**. The last of these, the **ovary**, the lower part of the pistil, is the beginning of the fruit; and when developed is itself subdivided.

§ 29. It has been explained that the different parts of a flower are all modifications of leaves, that is, leaves changed more or less as required. Also it has been shewn that the ovary, style, and stigma of the pistil are each modifications of some part of a leaf.

Thus the broad blade of the leaf folds round, meeting at the edges to form the **ovary**, while the **midrib**, or **middle vein**, extends beyond to form the **style**, finishing in the delicate **stigma**.

The pistil of a plant has sometimes more than one of these folded leaves, in which case each leaf forms a distinct **ovary**, **style**, and **stigma**. Often, however, these ovaries, or the style, or the stigmas, are so united that they seem but one.

When the pistil is thus made up of more than one folded leaf, a new term is used. The whole seed part of the flower is still called the **pistil**, and each folded leaf is still divided into **ovary**, **style**, and **stigma**; but as one folded leaf cannot be called a pistil when there are several to make it up, each leaf is called a **carpel**.

When there is only one folded leaf it is both a **carpel** and a **pistil**; but when there are more leaves than one, each one is called a **carpel**, and the whole of them a **pistil**.

The **pistil** is generally composed of **three parts**; the place containing the seed, a thin tube rising above this, and a soft top to this tube. Sometimes the tube is very short, sometimes altogether absent. Each of these three parts has a distinguishing name. The seed case is called the **ovary**, the tube, when present, is the **style**, and the top, upon which the pollen of the stamen is poured out, is the **stigma**.

The **ovary** is a hollow case at the bottom of the **pistil**. This hollow case contains the **ovules** or **future seeds**; and, together with these seeds when ripe, it forms the **fruit**, which will be described a few pages farther on.

The **stigma** is the upper portion of the pistil, above the **ovary**, and always communicating with it. The **stigma** is not a separate piece, that is, it could not be taken away. It is the upper portion of the **pistil**, of very delicate texture, and quite uncovered by the skin which is spread over every part of a plant except the **stigma** of the **pistil** and the ends of the roots.

The **stigma** may be said to be the upper portion of a pipe, which may be short or long, leading from the outside of the **pistil** to the inside of it, for the purpose of conducting the **pollen** of the **stamens** to the inside of the **ovary**, where the seeds are.

When this tube, of which the **stigma** is the top, is sufficiently long to have a separate name, it is called the **style**. These three parts, **ovary**, **style**, **stigma**, make up the whole of the **pistil**, or seed portion of the flower.

§ 30. The **pistil**, as has been already shown, is the reproductive portion of the flower, and of the plant; that is, it is the part that produces the seeds that, in turn, reproduce new plants of the same kind as that on which they grow.

The **pistil**, however, cannot do this work by itself entirely. The **pistil** is produced by the ordinary growth of the plant, and becomes a place for the seed to be in during its early growth, but it cannot of itself produce the actually growing portion of the seed. For this purpose the united action of **pistil** and **stamen** is required.

It has been already shown that this **united action** by **pistil** and **stamen** consists in the **stamen** sending out from itself a very fine powder, generally yellow in colour, which, when it falls upon the **stigma** of the **pistil** (that is, upon the top of the tube leading to the inside of the **pistil**, which top is very delicate, and not covered with any skin), passes down the tube into the inside of the **pistil**, which is called the **ovary**, where it touches the seed, and causes it to begin to grow.

This process of the **stamen**, by means of the **pollen**, giving to the seed in the **ovary** of the **pistil** the power of growing and becoming fertile, is called **fertilization**.

The **pistil** has been shown to consist of three parts, **ovary**, **style**, and **stigma**. In the same manner, the **stamen** generally consists of two parts, the small body containing the **pollen**, or **fertilizing powder**, and a thin thread-like stalk upon which it is supported.

The first of these, the **pollen-bearing** body, is called the **anther**; the second, or thread-like support, is called the **filament**. There cannot be a perfect **stamen** without the **anther**, but many **stamens** have no **filament**, the **anther** being without any stalk, as also some leaves are.

The **pollen** poured out by the **stamens** upon the **pistils** is composed of very small grains of a yellow substance. Each of these grains is a hollow globe, containing a fluid, which is poured out upon the seed when the grains have penetrated into the **ovary** of the **pistil**.

§ 31. The **pistil** is in the centre of the flower: the **stamens** are arranged round the **pistil**. The **stamen** and **pistil** together form the inner part of the flower: the outer part is the **floral envelope**.

This outer part, or **floral envelope**, is generally the largest, and almost always, the most gay and noticeable part of the flower. It consists sometimes of one row, and sometimes of two rows, of coloured leaves.

The outer row, when there are two, is generally thicker and smaller than the inner, the latter being generally very delicate in texture, and very gay in colour. The outer one is the **calyx**, the inner the **corolla**; when there is but one row that is generally called the **calyx**; but more commonly when there is only one row of leaves round the flower and they are coloured, the name of **perianth** is given to it.

The **corolla**, or inner row, (when there are two) is composed of several coloured leaves called **petals**. These **petals** are sometimes separate, and sometimes joined together by the edge so as to form one entire **envelope**.

The **corolla** is generally larger than the **calyx**, and the colour of it is very seldom green. The **calyx**, on the contrary, is generally of that colour.

Just as a leaf consists of a blade and a stalk, a **pistil** of an **ovary** and a **style**, and a **stamen** of an **anther** and a **filament**, so a **petal** (or single leaf of a **corolla**) consists of the coloured leaf and its stalk, which are called the **limb** and the **claw**, or sometimes the **lamina** and **unguis**, two Latin words meaning much the same as the English ones.

Also just as a leaf has sometimes no stalk, a **pistil** sometimes no **style**, or a **stamen** no **filament**, so also a **petal** has sometimes no **claw**.

§ 32. The **floral envelope**, especially the **corolla**, is generally the most beautiful part of a flower, but it is of no other use than to surround and protect the **stamens** and **pistils**, the parts of the flower really engaged in reproduction.

The **calyx** is the outer **floral envelope**, when there are two, and also the outer division of the flower itself. In colour it is almost always green, and is generally of thicker texture than the **corolla**.

Just as the **corolla** consists of several **petals** either separate or joined together at the edges, so the **calyx** is made up of several small leaves, called **sepals**, either separate or joined together at the edges.

The **calyx** is always formed before the **corolla**, and is generally of thicker and rougher texture. The **calyx** may be said to be a continuation of the outer portion of the flower stalk, while the **pistil** may be said to be a continuation of the inner portion of it. Between these two, the **calyx** outside and the **pistil** inside, are developed the **stamens** and the **corolla**.

Although the **petals** of the **corolla** and also the **sepals** of the **calyx** are sometimes joined together by the edges, they are always produced separately and distinct; being sometimes united afterwards. Thus when a **corolla** is said to be **mono-petalous**, or a **calyx** to be **mono-sepalous**, meaning with only one **petal** or one **sepal**, what is really meant is that the various **petals**, or **sepals**, have become united at the edge and form an unbroken **floral envelope**.

The **corolla** most frequently dies and falls off before the ripening of the fruit, but it sometimes remains. The **calyx**, on the other hand, sometimes falls off, but most frequently remains until the ripening of the fruit, which it sometimes becomes a part of, by growing with, and adhering to it.

Every part of a flower, the **calyx**, **corolla**, **stamens**, and **pistil**, is a modification of a leaf. Each of these begins as a leaf, and if it were in a place where a leaf ought to be, would become a leaf.

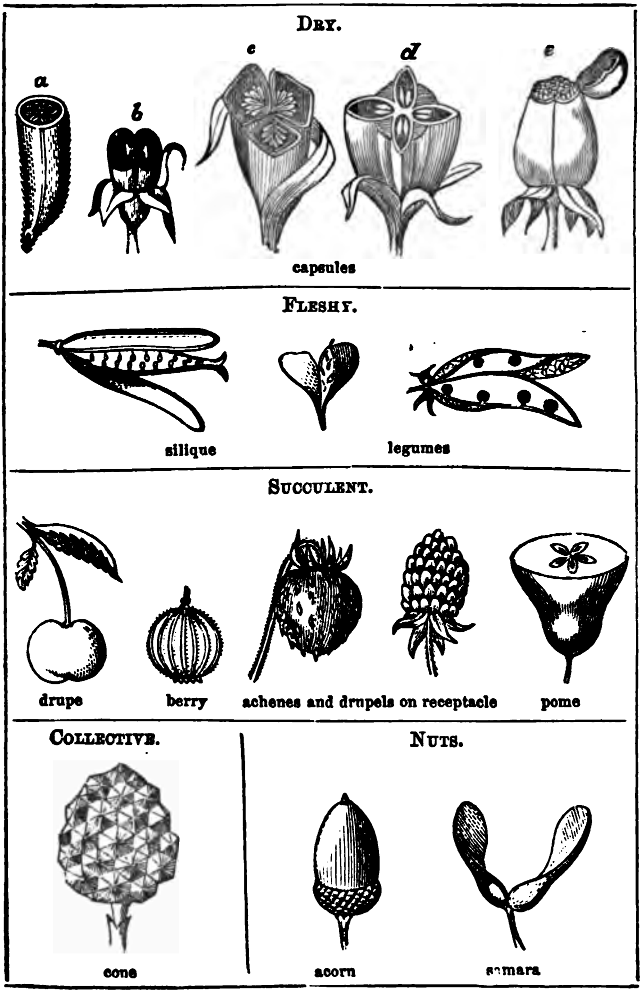
In a **petal** of the **corolla** the blade of the leaf becomes the **limb** of the petal, while the stalk of the leaf become the **claw** of the petal. This will explain why some petals, like some leaves, have no stalks, or claws.

In a **sepal** of the **calyx** the blade of the leaf becomes the blade of the **sepal**, while the stalk of the leaf becomes the stalk of the sepal. Here again the stalk of the sepal, like the stalk of the leaf, is sometimes absent.

§ 33. In a **stamen** the blade of the leaf is rolled up to form the **anther**, while the stalk forms the **filament** of the stamen. And, also, as some leaves have no stalks, so some stamens have no filaments.

In a **pistil** the blade of the leaf is folded round, meeting at the edges, (but not rolled up like the **anther** of the **stamen**). This makes the hollow space called the **ovary**, while the **midrib** (or continuation of the stalk) of the leaf continues beyond the body of the leaf to form the **style**, when there is one, and the end of the **midrib** forms the **stigma**.

PLATE XII.—FRUITS.



§ 34. It has been shown that there is a difference of structure between the root, stem and leaves of a plant of the **exogen** class, and the root stem and leaves of the plant of the **endogen** class: so that by examination of the root, the stem, or the leaves of a plant, it can be determined to which of these two great families it belongs.

The same thing is, to a less extent, true of the flower. It can generally, but not always as certainly, be guessed whether a plant is an **exogen** or an **endogen**, by the structure of the flower. If the **sepals** of the **calyx**, and the **petals** of the **corolla** are four, eight or twelve in number the plant is pretty sure to be an **exogen**. The same is generally true of a plant having the **sepals** and **petals** five or ten in number.

But if the number of **sepals** and **petals** be three or six, the plant most likely belongs to the **endogen** family. Still the structure of the flower is not so sure a test as the structure of the stem or the venation of the leaf.

THE FRUIT.

§ 35. The ripe **ovary** is called the **fruit**. It is the **last stage** of the annual life of the plant: it is the object of the whole economy of it. The drawing up of food, the digestion of it, the nutrition of the plant by it, the formation of the flower, the pouring out of the **pollen** of the **stamen** upon the **stigma** of the **pistil**; the passage of the **pollen-tubes** down the **style** into the **ovary**, and the fertilizing of the **ovules** by them; all these are directed mainly to the one object of forming the fruit containing the seeds of future plants.

Fruits are of various kinds and shapes. Cherries, gooseberries, nuts, peaches, chestnuts, oranges, apples, currants, acorns, strawberries, are all familiar to us by the name of fruits, but all fruits are not eatable. Every plant having a flower has also a fruit. Peas and beans are as much fruits as apples, or gooseberries.

§ 36. If an apple be carefully examined, some traces of the **calyx** will generally be found, showing that the **calyx** had adhered to the **ovary**. The trace generally visible is a piece of dry decayed leaf, round the **apex** of the fruit where the **style** had been, on the opposite side to the stalk. Therefore we know that the apple has been an inferior **ovary**. If the fruit be cut open the seeds will be found in the centre, imbedded in the fleshy part of the apple, and ranged close together round the centre showing the **attachment** (as it is called) to be **axile**.

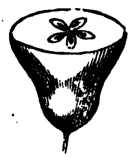


Fig. 213.

Fig. 213.

§ 37. Take now an orange; in this, if found at all, the remains of the **calyx** will be found at the base of the fruit only, showing that the fruit had been free from the **calyx**, that is, the orange is the **ovary** alone ripened. The seed will be found, on opening it, in the various **carpels**, which can be distinctly told by their being so easily separated by the finger, without at all breaking the skin or losing any of the juice. Each piece thus easily parted is a **carpel**, containing seed.

§ 38. A cherry, in the same way, will be found to be a ripe **ovary**, without any adherent **calyx**; that is, the **ovary** was superior (or above the **calyx**) and ripened by itself. Inside the pulpy part of the fruit will be found a hard stone, and inside the stone the seed. This is the seed, and the pulpy part is the **ovary**. It would also seem that the stone was a part of the ovary. This kind of fruit is called a **drupe**, and it must be considered that the **ovary** has divided into two parts a pulpy outside, and a hard inside.

§ 39. A strawberry is different from any of these. The real fruits of the strawberry are the little seed-like looking bodies on the outside of it.

The main substance of a strawberry is not properly a part of the fruit at all, but a succulent receptacle, or bed on which the **carpels** grew. Each of these little **achenes**, as they are called, is a **carpel**, having a seed inside it.

In fact strawberries, blackberries, raspberries, are not berries at all. A berry is pulpy, does not open to let out the seeds, and is one-celled. Such are gooseberries, grapes, currants, &c.

Plate XII. shows the chief varieties of fruits.

§ 40. Fig. 214, *a*, *b*, *c*, *d*, *e*, are 5 varieties of **capsule.** A capsule is a fruit that has all the **carpels** growing together, dry, and opens to let the ripe seeds out. Fig. 214 *a*, is a **capsule** with one cell, fig. 214 *b*, a capsule with one cell very full of seeds, and fig. 214 *c*, is a two-celled capsule, and fig. 214 *d*, a four-celled one. The part of the **ovary** to which the seeds are attached is called a **placenta**. The **capsules** have generally **central placentas**, that is, the **placenta** is in the middle. When three or more **placentas** are together, as in figs. 214 *d*, *e*, the **placenta** is said to be axillary, or in the **axils** of the **dissepiments**, as the partitions are called.

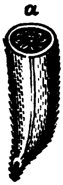


Fig. 214 *a*.

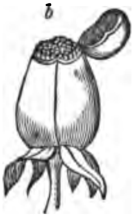


Fig. 214 *b*.

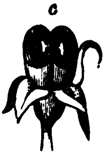


Fig. 214 *c*.

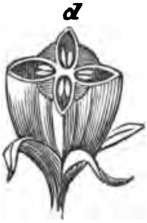


Fig. 214 *d*.

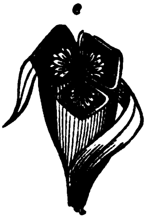


Fig. 214 *e*.

Fleshy fruits :—A **legume** is a fruit long and flat as a pea or bean, opening at one or both sides, with the seeds attached to one side. This kind of attachment is called **sutural**. The **dorsal suture** is the back of the **legume**, the **ventral suture** is the front of it. In fig. 216, the seeds are attached to the **dorsal** or back **suture**. Fig. 215 *b* is a small and broad **legume**. Fig. 215 *a*, is a **silique** a fruit somewhat

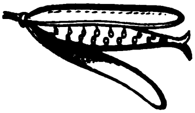


Fig. 215 *a*.

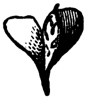


Fig. 215 *b*

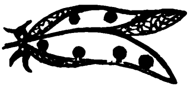


Fig. 216.

resembling a **legume**, but with the seeds attached to a kind of framework in the middle, with the two valves or sides of the **silique** opening from it, one on either side. If a **silique** is short and wide, it is called a **silicle.**

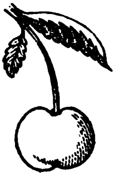


Fig. 217.

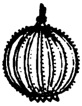


Fig. 218.

Succulent fruits:—The examples of this are a **drupe**, **berry**, **achenes** on a fleshy receptacle, **drupels** on a receptacle, and a **pome** or apple. The **drupe** has a pulpy outside and a stone inside, with the seed inside the stone, fig. 217, as a plum. A **berry** is pulpy with one cell, and many seeds, fig. 218, a currant, or gooseberry. A **pome** is succulent, with leathery rind, and seeds in the centre, as an apple. An **achene** is a small dry fruit containing one seed. Fig 219 is a strawberry, that is a number of **achenes** on a succulent receptacle: fig. 220, is a number of **drupules** (or small **drupes**) on a receptacle. Here the **drupules** are succulent, and not the receptacle, as the raspberry.

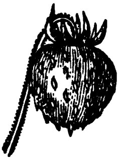


Fig. 219.

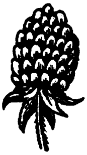


Fig. 220.

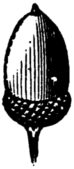


Fig. 221.

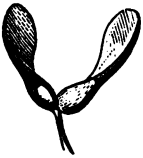


Fig. 222.

Nuts:—Hard and bony fruits, with only one **carpel**, or with more than one united into one, with the seed inside. Fig. 221 is the nut of the oak, called an acorn. Fig. 222 is a **samara**, that is, a nut with wings to it.

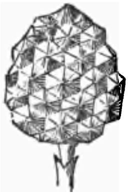


Fig. 223.

Collective Fruits:—This is where a number of flowers have grown close together, and the **carpels** also grow together. A mulberry is an example, a fig is another, also the cone of the fir-tree. Fig. 223 is a cone with the seeds outside the hard body just covered by scaly **bracts.**

The fig is a collective fruit. The small things generally mistaken for seeds are in reality fruits growing inside the common receptacle.

THE SEED.

§ 41. The **ovary** of the **pistil** has one or more small bodies called **ovules**. These **ovules**, when the **pollen** of the **stamens** reaches them, begin to grow and become **seeds**, from which seeds fresh plants grow.

In each seed is the beginning of a root, the beginning of a stem, and nourishment sufficient to feed the growing root and stem until they can get nourishment for themselves.

The young stem is called the **plumule**, the young root is called the **radicle**, the nourishment for them when growing is generally in the form of **albumen**.

Fig. 224 shows a few varieties of seeds, *a*, in each of them is the **cotyledons** or seed leaves; *b* is the **plumule** or young stem; *c*, the **radicle** or young root.

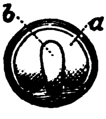


Fig. 224 *a*.

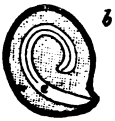


Fig. 224 *b*.

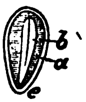


Fig. 224 *c*.

Fig. 225 shows seeds in the act of growing in which the young stem and young root are clearly distinguishable.

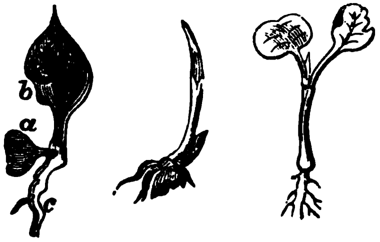


Fig. 225.

PART II.

PHYSIOLOGY OF PLANTS.

§ 42. A seed is the beginning and end of a plant. From a seed a plant is first produced, and the whole life and energies of a plant are devoted, after it is grown, to the reproduction of similar seeds. So that a plant begins from one seed, and ends in producing others.

For this seed to grow, and become a plant, it must be under the influence of heat and moisture. If a seed is placed in the ground (from which to derive food) it absorbs the moisture from the ground. If this is cold, the seed rots and comes to nothing. If it is warm the seed begins to grow.

By growing is meant this: the **embryo** of the seed commences its vital action, that is its life, by sending up to the surface of the ground the beginning of the **stem** to seek the light, and the beginning of the root down into the soil to seek food.

If the seed is so deep in the ground that the stem is not strong enough to force its way to the surface and obtain light, the plant dies. Also if the soil is too hard for the root to penetrate it, or too dry to supply food, the plant dies.

So that while heat and moisture are required for the seed to commence its life, light and food from the earth are, more or less, requisite for this life to continue.

§ 43. If light and food are attainable the root continues to grow downwards and the stem upwards. The food required to support this vital action is obtained from the ground, but the plant has to live during the time the roots are forming and making their way through the ground to find their food. This early life of a plant is supplied with nourishment by means of the **cotyledons** or **seed-leaves**, which are folded up in the seed, and which, in some plants, are the first part to appear above the ground.

As the roots become capable of feeding the plant, the stem lengthens and other leaves appear. These leaves perform another important vital function, that of **digestion**, that is, the food brought up from the root is prepared by the leaves to form additional substance to the plant, to increase its length or thickness: and so it goes on till the plant is full grown.

§ 44. This continues until the flower is formed. Then the vital function of reproduction is begun and carried on by the different parts of the flower; and with this the life of the tree is completed.

The three functions of **growth**, **nourishment**, and **reproduction**, are respectively performed by the seed, the root, the leaves, and the flower: the production of a plant from the seed being the beginning of its life, and the production of seeds from the plant being the end.

§ 45. The **food** of plants is of very different kinds, and derived from very different sources, but it must be all reduced to a liquid form, so as to be able to pass up the small tubes of the root, and through the stem and branches into the leaves.

A plant is made of solid matters, such as wood, bark, pith, &c. These solid matters have to pass from the ground through the roots, and to do this they must be in a liquid form, but they return to their solid form when they reach the place where they are required to increase the bulk of the plant.

Food of plants is of three kinds, water, gases, and minerals. The principal minerals are soda, potash, phosphorus, sulphur, lime and flint. The gases chiefly wanted are carbonic acid and ammonia.

§ 46. By a gas is meant a substance which cannot be seen from its extreme thinness. We have examples of gases in the gas we burn in shops and street-lamps, and in hartshorn or smelling salts. This last, the hartshorn, is the ammonia which is one of the two gases required as food for plants.

The other gas, carbonic acid, is the same as is breathed out by men when they respire. When a man breathes he draws in fresh air from the atmosphere, and sends out carbonic acid, which though poison to animals is absolutely essential to the growth of plants.

These two gases, ammonia and carbonic acid, are compound; that is, they can be taken to pieces, as it were, and are then found to be made up of other substances mixed together. These other substances are simple, that is, they cannot be taken to pieces, or in any way be found to be made of more than one material.

§ 47. These simple substances are four in number, oxygen, hydrogen, nitrogen and carbon. When they are pure, that is, unmixed with each other, or with any other substance, the three first, oxygen, hydrogen and nitrogen, are always gases, and the last, carbon, always a solid.

The two gases, carbonic acid and ammonia, spoken of as necessary food for plants are made of these simple gases. So also is water.

Ammonia is made by a mixture of Nitrogen and Hydrogen.
Carbonic acid „ „ Carbon and Oxygen.
Water „ „ „ Oxygen and Hydrogen.

Another way of showing this is thus:—

Oxygen with Carbon=Carbonic Acid.
Oxygen with Hydrogen=Water.
Nitrogen with Hydrogen=Ammonia.

The breathing of animals, and burning of wood and coal, cause the presence of vast quantities of carbonic acid in the air. This is washed down by rain into the earth, and being thus mixed with the water is drawn up with it by the roots.

Another great source of carbonic acid is the earth itself. In the neighbourhood of volcanoes the water of lakes and rivers always contains carbonic acid. It is in this way that the quantity of this gas has continually increased with the number of plants and animals requiring it.

The other gas, ammonia, is produced by the decay of manure, the burning of wood and coal, and is also found in the neighbourhood of volcanoes.

§ 48. The mineral substances required as food, that is, the soda, potash, phosphorus, sulphur, lime, and flint, are found already in the earth, so that when the water, mixed with the two gases, carbonic acid and ammonia, soaks down through the surface of the ground, all the substances required for food are within the reach of the roots of the plants.

Just as the gases mix with water to enter the root tubes, so do the minerals. Just as sugar can be dissolved in water, and be separated into pieces so small that they cannot be seen, so can these minerals. In this way, also, they enter, with the water, the small tubes of the roots.

§ 49. This mixture of water, gases, and minerals, is called sap. The sap of a plant scarcely ever contains all the materials now mentioned, but it always contains water, carbonic acid, and ammonia, and some of the six mineral substances named.

Although all sap contains ammonia and carbonic acid, these two gases are not essential to the nourishment of plants—but the substances of which they are composed are essential. Thus, a plant absorbs carbonic acid, which is composed of carbon and oxygen, but it only wants the carbon, not the oxygen. The carbonic acid is only the means by which the carbon, which is naturally solid, is conveyed into the body of the plant.

In the same way ammonia, which is a compound of Nitrogen and Hydrogen, is the means by which Nitrogen is conveyed into the plant.

The sap being in the ground in the form of water containing carbonic acid and ammonia, together with some or other of the minerals, soda, potash, phosphorus, sulphur, lime, and flint, enters the root by way of the small tubes or fibres branching from it.

§ 50. The substance of a plant is composed of two very different kinds of material called **tissues.** One of these is soft and pulpy, somewhat resembling sponge in character: the other is tough and stringy, resembling bundles of very fine straws. The soft, pulpy tissue is called **cellular tissue**; the tough stringy is called **vascular tissue.**

A plant just springing up from a seed is almost entirely cellular tissue, and it is through this tissue that the sap passes up from the root through the stem. The seed of every plant contains in itself sufficient nourishment to feed the plant in its first stage, until the root is formed, and capable of drawing food from the ground.

§ 51. By the time the seed leaves, called **cotyledons,** which supply the food during the early life of the plant, are exhausted, the root is ready to provide a further supply of nourishment, which it finds in the water, gases, and minerals of the earth.

This nourishment, the **sap**, passes more ready and quickly through the soft, spongy, cellular tissue than through the tough, stringy, vascular tissue. A plant in its first stage is composed almost entirely of this soft, spongy tissue, so that the sap passes through it very readily, ascending to the leaves.

By means of the leaves the materials of the sap are separated: those required for the growth of the plant remain to increase its size, while those not necessary pass through the little holes in the surface of the leaves into the atmosphere.

In this way the plant increases in length, and in many cases in thickness, by the addition of fresh, pulpy, cellular tissue in all plants, and in woody plants by the addition also of tough, stringy, vascular tissue.

This additional substance of the plant is manufactured by the action of the leaves upon the sap rising from the root: and when so manufactured it is sent downward from the leaf to the place where wanted.

This rise of sap and fall of new substance ceases at the approach of winter, during which period the plant exists, that is, continues alive, but does not grow. As it were, it goes to sleep until the return of spring.

§ 52. At the beginning of spring the buds that are to become new leaves unfold, and the sap that is in store in the stem passes into them, enabling them to grow, while the space thus emptied in the body of the plant, is filled again by fresh food pumped up from the ground through the root. The leaf-buds thus act as pumps to draw the sap up from the earth.

The sap always rises through the newest portion of the stem, that is the portion made out of the sap of the last year. **Tissue**, after a few years, becomes hard, and clogged up, and unable to allow sap to pass.

The organized matter forming new substance of the plant is sent down by the leaves through the bark, or outer covering of the tree, until it reaches the place where it is wanted.

The change that takes place in the leaves is owing to the action of light and heat, which separate the sap into its different materials. In the night time this change does not go on; the carbonic acid, &c., passing out unchanged through the little holes of the leaf surface, called **stomates.**

§ 53. Thus the plant goes on growing, nourished by the sap drawn from the earth, increasing in size, and bearing more leaves, until the time of flowering comes. At this time the buds at the end of some of the branches become swollen, and at last bring forth a cluster of **pedicels**, or flower-stalks, each having a bud at the end.

These buds unfold in a similar manner to leaf-buds, but, instead of being composed of regular leaves, they bear the **sepals**, **petals**, **stamens**, and **pistil** of a flower. These are made of the same materials as ordinary leaves, and are, in every respect but that of form, ordinary leaves, being, in fact, really ordinary leaves changed into the different parts of the flower.

A flower may, therefore, be said to be a number of ordinary leaves, arranged in four rows, of which the inner row bear seed, the next fructify the inner row by their **pollen**, while the outer two rows surround the inner two, and protect them during the earlier stages of reproduction, each row being altered from the ordinary form so far as is necessary for their particular work.

§ 54. After the **stamens** have emptied their **pollen** upon the **stigma** of the **pistil**, and the latter has begun to grow, the **petals** of the **corolla** and the **stamens** fade and drop off. Sometimes, the **sepals** of the **calyx** also fade away, sometimes they remain and form part of the fruit.

The sap passes through the **pedicels**, into the different parts of the flower, in the same way as to the ordinary leaves, and the flower does the same work in altering the sap, and preparing it for the plant, as the ordinary leaves. But, when the fruit begins to ripen, this process stops; and the fruit requires the whole of the sap for its ripening, and does not give off oxygen into the air, as ordinary leaves do.

As soon as the fruit is completely ripe, it can receive no more sap. The **pedicel**, or fruit stalk, decays, and the fruit falls, by its own weight, to the ground, where it decays, and, if the earth be suitable, the seeds in it take root, and produce plants, of a kind similar to that from which they were themselves produced.

This is the usual routine of the life of a plant, from the germination of a seed until the production of fresh seeds from the plant produced by it—so that, as said before, a seed is the beginning and end of a plant.

§ 55. Two different kinds of **tissue** have been spoken of as making up plants generally— a soft, spongy tissue, called **cellular**, and a tough, stringy tissue called **vascular.**

Every part of every plant is made up of little cells, or *very* small boxes, as it were—so small, that a microscope is necessary for an examination. These little cells are much the same in length, breadth, and thickness. Each one is hollow, and contains some kind of vegetable product, either oil, or sugar, or starch, &c., &c.

The part of a plant composed of a number of these cells together, is soft and spongy, and is called **cellular**; but when a number of these cells in a row become joined together so as to form a tube or pipe, the sides become tough and stringy, and form the tissue called **vascular**.

The great mass of a plant is generally composed of **cellular tissue**, or cells, having a network of **vascular tissue** imbedded in it. Somewhat in the same way as a man's body is made up of soft, pulpy flesh, having a framework of bones imbedded in it.

PART III.

CLASSIFICATION OF PLANTS.

§ 56. There are a great many different kinds of plants in the world: plants with flowers, and plants without flowers; plants having both **calyx** and **corolla**, only a **calyx**, or without either **calyx** or **corolla**. Again some plants have two **stamens**, some have six or eight, some have twenty or more, sometimes so many that they cannot readily be counted. In some plants the **stamens** are all separate, in others in bundles of two or more. Also some plants have only one **carpel** in the **pistil**, others have two, others more than two. In some the **carpels** are distinct from each other, in others they are joined together. Some plants have only one seed in the **carpel**, others have many. There are also endless differences among plants as to the shape, size, and position of the leaves, the arrangement of the flowers, the nature of the root, of the stem, and of the fruit.

There are about 100,000, or more, different kinds of plants. Of these no two are exactly alike. If any two be examined at the same time some difference will be found, either in the root, the stem, the leaves, or the flowers.

Sometimes the difference will be very slight, perhaps, only the nature of the fruit, the number of **stamens**, or the arrangement of the leaves, but no two kinds of flower are ever exactly alike. Some difference, either of structure or arrangement, will always be found to exist.

§ 57. It is found a great convenience to put all kinds of plants that are not very much unlike in general character together; and thus to divide the whole number of plants into groups; each group having some general character in common. It will also generally be found that besides the one point of general resemblance, each group has some other character in common.

The whole number of plants are, in fact, naturally divided into groups, each group being generally unlike any other; while all the plants in each group are generally alike; just as all men are divided into nations, English, French, Spanish, German, &c. &c., each nation being made up of men generally like each other; and each nation being also generally unlike any other.

§ 58. It would seem, at first sight, the easiest thing possible to divide all plants into trees, shrubs, and herbs; and this would seem as natural as easy. If, however, the attempt were made, as it no doubt often has been, it would very soon be found to be both a very difficult and a very unnatural thing to do. And this for two reasons: First, very often it is found that the same plant is a herb or shrub in one country, and a tree in another, so that any division of plants into trees and herbs made in a northern country, where the climate is colder, would not hold good for a southern country, where the climate is warmer; and also, conversely, a division of plants into trees and herbs made for a warm southern country, would not be correct for a cold northern one. Secondly, a plant is sometimes a herb when young, and a tree when old; so that in any division of plants into trees and herbs, all the young specimens of such a plant would be in one class, that of herbs, while all the full grown specimens would be in the other class, that of trees.

For example, the mallow is a herb in the north of Europe, and a tree in the south; also the lavender plant is a herb when young, and a tree when old.

Therefore, when it was first attempted to arrange plants in classes, it was soon found that the division that first offered itself, that of trees, shrubs, and herbs, was neither an easy nor a natural one; but, on the contrary, both impossible and against the nature of plants.

§ 59. The next apparent division was found a better one; it was that of all plants into two great classes, plants having distinct and clearly visible flowers, and plants having no visible flowers. This division was really a good and natural one, since it was found that the plants having flowers were also different in many other respects from plants having none.

The difference between a plant that bears flowers and a plant bearing none is found to extend to the arrangement of the wood, the veining of the leaves, and to the manner in which the young plants are produced from the seed.

In the flowering plants the wood is arranged regularly, in the flowerless plants it is arranged irregularly, or in a zig-zag manner. In a flowering plant the leaves have their veins arranged either parallel or reticulated; in a flowerless plant the leaves have either no veins at all, or very few straight ones, or, at the highest, the veins are simply forked.

This then is the first natural division of plants: into plants having flowers, and plants having none; or, in other words, into **flowering** and **flowerless** plants. The **flowering** plants have always roots, stems, leaves, flowers, fruits, and seeds: the **flowerless** have sometimes stems and leaves, but are more frequently a mass of soft pulpy tissue, in which it is impossible to distinguish either stem or leaves.

§ 60. Starting from this grand division we are able to again divide these groups. The **flowering** plants divide themselves, naturally, into two classes, between which a difference is found to exist in the root, stem, leaves, flowers, and seeds.

We have now three great classes of plants: the one great division of **flowerless**, and the two into which **flowering** plants are divided, and which are called **Exogens** and **Endogens**.

These may be shewn thus :—

$$\text{Plants}\left\{\begin{array}{c}\text{are}\\ \text{divided}\\ \text{into}\end{array}\right.\left\{\begin{array}{l}\textbf{Flowering plants}\left\{\begin{array}{c}\text{and these}\\ \text{are again}\\ \text{divided}\\ \text{into}\end{array}\right.\left\{\begin{array}{c}\textbf{Exogens}\\ \text{and}\\ \textbf{Endogens}\end{array}\right.\\ \qquad\qquad\text{and}\\ \textbf{Flowerless plants,}\ \text{called}\ \ \textbf{Acrogens}\end{array}\right.$$

§ 61. The difference between these three great classes of plants are very decided and easily observable. Each of the three is different from the other two in **root, stem, leaves, flowers,** and **fruit**; and also in general character and manner of growth.

The **root** in **exogens** is formed by the radicle itself growing and forming the root; in **endogens** the root grows from within the radicle, lengthening beyond it. In **acrogens** a root will grow from any part of the **spore** upon which the necessary moisture and heat operate.

The **stem** in **exogens** is formed by wood being regularly arranged in bundles round a central column of pith, and surrounded by a coating of bark: in **endogens** the bundles of wood and pith are mixed together without much regularity, and without either centre of pith or coating of bark.

Here the **exogen** and **endogen stems** are both made up by a union of soft, pulpy, cellular tissue, with the tough stringy vascular tissue; but in the third class of plants, the **acrogen,** the whole mass of the plant is almost entirely cellular, there being little, if any, woody or vascular tissue; and, generally speaking, no distinction of stem from the general substance of the plant.

The **leaves** in **exogens** have their veins arranged in a network, dividing and subdividing from the **midrib** or main vein, while in **endogens** the veins of the leaves are generally parallel with the **midrib,** and not subdivided; and in **acrogens** the leaves (when there are any), are either not veined at all, or have only one or two very simple veins, either straight or forked.

The **flowers** in **exogens** have generally either 4 or 5 sepals, petals, and stamens, or some multiple of 4, as 8 or 12; or of 5, as 10 or 15; while **endogens** have generally their sepals, petals, and stamens arranged in groups of 3, 6, or 9. The **acrogens** have no flowers, and therefore no sepals, petals, or stamens at all.

The **fruit** in **exogens** differs from the **fruit** in **endogens**, in the fact that the seed in an **exogen** fruit has always two **cotyledons** or seed leaves, (that is two seed leaves that appear above ground when the seed first begins to grow, and which do the work of regular leaves, until these regular leaves have time to grow), while the seed of an **endogen** plant has only one, and the seed of an **acrogen** none at all.

§ 62. These differences are shewn altogether, thus :—

Class of Plants.	Root.	Stem.	Leaves.	Flower.	Fruit.
Exogens	The radicle of the seed becomes the root.	With central column of pith, and covering of bark, the wood being in bundles round the pith.	With veins reticulating, branching from midrib.	Sepals, petals, and stamens, in groups of either 5, 10, or 15; or of 4, 8, or 12.	The ripened pistil containing seeds with 2 seed leaves.
Endogens	The root grows from within the radicle of the seed.	The wood in bundles irregularly; no central pith or outer bark.	With veins parallel to midrib,	Sepals, petals, and stamens, in groups of either 3, 6, 9, or 12.	The ripened pistil containing seeds with only one seed leaf.
Acrogens	The root grows from any point of the seed.	The wood, when there is any, arranged very irregularly and zig-zag.	No veins, or simply forked veins.	No flowers.	No fruit or seed; but spores or cells on the leaves: no seed leaves.

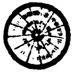
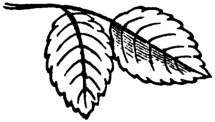
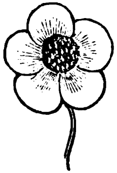
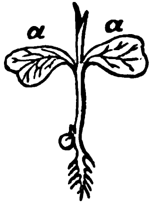
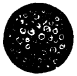
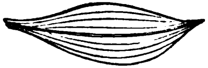
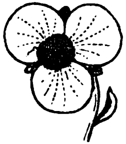
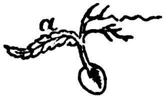
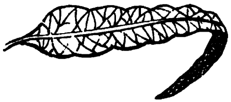
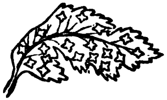
From the number of seed leaves in the fruit, another name is given to these great classes of **exogens**, **endogens**, and **acrogens**. The seed leaves being called **cotyledons**. **Exogens**, which have 2 seed leaves, are called **di-cotyledons** (di meaning two); **endogens**, which have 1 seed leaf, are called **mono-cotyledons** (mono meaning one;) and **acrogens**, which have no seed leaves, are called **a-cotyledons** (a meaning without any).

§ 63. So that the division of plants into these three great classes may also be shewn thus :—

Plants are divided into	**Flowering plants**	divided again into	**Di-cotyledonous plants** and **Mono-cotyledonous plants**
	Flowerless plants	called	**A-cotyledonous plants.**

From this it will be seen that an **exogen** is also a **di-cotyledon**, "**exogenous plant**" being only another name for "**di-cotyledonous plant**;" also **endogen** and **mono-cotyledon** are the same; an **endogenous** plant being also a **mono-cotyledonous** plant; and lastly, an **acrogen** is the same as an **a-cotyledon**.

This is still more evident when the table in section 62 is repeated here, with the two names together. Instead of the verbal definition being repeated, a figure is given.

CLASS OF PLANT.	STEM.	LEAVES.	FLOWER.	SEED.
Exogens, or **Di-cotyledons**......				 *a a* 2 seed leaves.
Endogens, or **Mono-cotyledons** ..				 *a* 1 seed leaf,
Acrogens, or **Acotyledons**	No stem except in a few orders.		No flower, but small capsules, often very minute, containing seeds.	

§ 64. These three classes of **exogens, endogens,** and **acrogens,** or (to use the corresponding synonymes), of **di-cotyledons, mono-cotyledons,** and **a-cotyledons,** are still very large, since they comprise the whole of the more than 100,000 different kinds of plants that exist.

Therefore, having first ascertained into what great divisions plants naturally fall, the next thing to be done is to re-divide these great groups into smaller ones. Thus, taking the **exogens,** or **di-cotyledons,** plants, they have generally all the same way of pruning the root, the same kind of stem, the same reticulation in the leaves, the same general number, four or five, in the parts of the flowers, and seeds with two seed-leaves; but there are differences in other respects by means of which they may be put in smaller groups.

It will be found, too, that these differences are according to certain systems; that plants do, *naturally*, divide themselves into groups of similar construction. These differences of construction are most regular in the parts of the flower, and in the fruit; and, therefore, it is with reference to these differences (rather than to differences in the stem or in the leaves) that the great class of **exogens** is divided.

The chief points observed are:—

Firstly. Whether the **stamens** grow from the bottom of the flower, quite distinct from the **pistil**; or whether they adhere to either the **corolla** or the **calyx.**

Secondly. Whether the flower has both **calyx** and **corolla,** or only one, or neither, of these floral envelopes.

Thirdly. Whether the **petals** of the **corolla** are distinct and separate, or joined together.

Other differences are, whether the **carpels** of the **pistil** are distinct or joined; whether they contain one or more seeds; whether the seeds adhere to the seeds of the **ovary** or to the centre. Other differences, again, are noticed in the shape of the **ovary,** the manner of the **pollen** coming out of the **anthers**, the contents of the **ovule**, and in many other minor matters.

Many of these differences require the use of the microscope to notice them; but the presence or absence of the calyx or corolla, the way in which the stamens grow, and the joining or separation of the petals of the corolla are generally more easily observable; and upon these characters it is that the first subdivision of **exogen** takes place.

§ 65. It is noticed that, generally, when the stamens grow by themselves distinct from the pistil, corolla, or calyx, that, also, these other parts of the flower, in like manner, grow distinct and separate from each other. This group, or sub-class, is the most highly organized among plants, and the name of **Thalamifloræ** is given to it.

In the next group of **exogens** the sepals and petals grow distinct and separate, but the stamens, instead of growing also distinct and separate by themselves, adhere for part of their length to the sepals of the calyx. From this adhesion of the stamens to the calyx, this group is called **Calycifloræ**.

In the third group of **exogens** we have the calyx, as usual, of separate sepals, but the petals of the corolla are joined together by their edges, making, as it were, but one petal of the whole, while the stamens adhere to the petals; so that the character of this group is to have the petals growing together in one, and the stamens growing with them. This group is called **Corollifloræ**.

The fourth, and last group of **exogens** have no corolla, and sometimes no calyx. From this fact of never having more than one floral envelope this group is **Mono-chlamydeæ**, meaning **one envelope**. All flowers having two floral envelopes are called **Di-chlamydeæ**.

This subdivision may be shown thus :—

Exogens or **Di-cotyledons**	are divided into	**Di-chlamydeæ,** having flowers with calyx and corolla,	and these are again divided into	**Thalamifloræ**	The flowers having sepal, petal, stamen and pistil quite distinct.
				Calycifloræ	The flowers having sepals and petals distinct, but the stamens growing to the sepals.
				Corollifloræ	The flowers having the sepals distinct, but the petals joined together, and the stamens growing to the petals.
		Mono-chlamydeæ having flowers with only calyx, or none			The flowers having stamens and pistils but no corolla, and sometimes no calyx.

Each of these four groups (besides having the parts of the flowers growing as described under each heading) also possesses, in common with the other three, the distinct features of the great division of plants called **exogens** or **di-cotyledons**, that is, every plant, whether **thalamifloral**, **calycifloral**, **corollifloral**, or **monochlamydeous**, has the root, stem, leaf-veining, and two seed leaves already spoken of as distinguishing the **exogen** from the **endogen** and **acrogen.**

If, therefore, we find a plant having the root, stem and leaf-veining of an **exogen,** we examine the flower more minutely to see to what division of **exogen** it belongs. If the different parts of the flower, sepals, petals, stamens, and pistils grow distinct from each other, it is one of the group **thalamifloræ** ; if the stamens adhere to the calyx it is one of the **calycifloræ**; if the stamen adhere to the corolla, and the petals are joined by their edges, it is one of the **corollifloræ** ; and, lastly, if there be no corolla, or neither corolla nor calyx, it is one of the **mono-chlamydeæ.**

§ 66. Thus three stages of division have been arrived at. Plants generally have been divided into **exogens,** **endogens,** and **acrogens.** Of these, **exogens** have been again divided into **di-chlamydeæ,** and **mono-chlamydeæ** ;

and of these **di-chlamydeæ** have been subdivided into **thalamiflorals**, **calycifiorals**, and **corollifiorals**. This is shown completely in the following diagram.

Plants are divided into
- **Exogens** or **Di-cotyledons** are divided into
  - **Di-chlamydeæ** or plants with two floral envelopes are divided into
    - **Thalamifloræ**, having flowers with sepals, petals, stamens, pistils, all separate and distinct.
    - **Calycifloræ**, with sepals and petals distinct, but stamens adhering to the sepals.
    - **Corollifloræ**, with sepals distinct, petals joined together, and stamens joined to the petals.
  - **Mono-chlamydeæ**, or plants with one floral envelope.
- **Endogens** or **Mono-cotyledons.**
- **Acrogens** or **A-cotyledons.**

We have thus **six groups** of plants:—

1. **Thalamifloræ,**	These 3 make up **Di-chlamydeæ**	These 4 make up **Exogens** or **Di-cotyledons.**
2. **Calycifloræ,**		
3. **Corollifloræ,**		
4. **Monochlamydeæ,**		
5. **Endogens,** and		
6. **Acrogens.**		

Each of these six groups has its special distinguishing features; so that a plant may readily be placed in the group to which it belongs to from an inspection of its stem, leaves, and flowers. If it have no stem, leaves, or flowers to inspect, then it belongs to the **acrogen** group. If, having stem, leaves, and flowers, the stem has the wood irregularly arranged, the leaves have parallel veining, and the flowers have their sepals, petals, &c., in numbers of three, six, or nine, the plant belongs to the group of **endogens**; if the stem have a pithy centre and covering of bark, the plant belongs to one of the first

PLATE XIII.

CLASS **EXOGENS.** SUB-CLASS **THALAMIFLORÆ.**

ORDERS.	CHIEF GENERA. (Subdivision of Order.)	SPECIMENS.
RANUNCULACEÆ. *Buttercups.* Herbs, growing in cold damp places, juice acrid and poisonous.	*Ranunculus*	butter cup.
	Anemone	wind flower.
	Clematis	traveller's joy.
	Helleborus	Christmas rose.
	Caltha	marigold.
	Pœonia	pœony.
	Delphinum	larkspur.
	Aconitum (most deadly poison)	monkswood (aconite) or wolf's bane.
	Aquilegia	columbine.
PAPAVERACEÆ. *Poppies.* Herbs, growing in corn fields and coasts, oily and narcotic (sleep causing).	*Papaver*	corn poppy (opium).
	Glaucium	horn poppy.
	Meconopsis	Welch poppy.
	Rœmeris	violet poppy.
	Chelidonium	celandine.
NYMPHŒACEÆ. *Water Lilies.* Aquatic plants, floating leaves, rooting in the mud at the bottom.	*Nymphœa*	white water lily, lotus.
	Nuphar	yellow water lily.
	Euryale	Indian lily.
CRUCIFERÆ. *Cabbages.* Herbs, very various in kinds, growing in all temperate climates; many of them very useful to man.	*Cheiranthus*	wallflower.
	Brassica	cabbage, turnip.
	Raphanus	radish.
	Cardamine	ladies' smock.
	Nasturtium	water-cress.
	Sinopis	mustard.
	Capsella	shepherd's purse.
	Iberis	candytuft.
VIOLACEÆ. *Violets.* Herbs, with handsome irregular flowers, and beautiful velvety petals, growing in hedges and roadsides.	*Cephælis*	ipecacuanha.
	Ionidium	ionidia.
	Viola	sweet violet.

PLATE XIII.—*continued.*

CLASS **EXOGENS.** SUB-CLASS **THALAMIFLORÆ.**

ORDERS.	CHIEF GENERA. (Subdivision of Orders.)	SPECIMENS.
LINACEÆ. *Flax.* Herbs or shrubs, from which linen is made, growing in low grounds beside rivers.	*Linum*	common flax.
TILIACEÆ. *Lime Trees.* Trees, large handsome, with fragrant flowers, much used for avenues to public places in Europe.	*Tilia*	common lime tree.
AURANTIACEÆ. *Orange trees.* Trees, growing wild in India and China, and cultivated in South Europe, and in hot houses in England.	*Citrus*	sweet orange tree. bitter orange tree. shaddock tree. lemon tree.

four classes, but the flower must be examined to show which.

THALAMIFLORÆ.

§ 67. The first group, **thalamifloræ**, consist of all the plants belonging to the class of **exogen**, that have both calyx and corolla, and also the sepals of the calyx, the petals of the corolla, and the stamens, growing quite distinct and free from each other. In other words, it contains the plants that are most highly organized, having every part of their structure fully developed.

As specimens of this group of plants may be given the common **buttercup**, common **poppy**, **water lily**, common **wallflower**, **sweet violet**, common **flax**, **lime tree**, and **orange tree**. At first sight these seem very different indeed. It would seem, for a moment, absurd to put the pretty little violet and the tiny butter-cup in the same group as the water lily and the lime tree.

It has been, however, pointed out that plants cannot be divided according to their size, and that the things to be really noticed are the structure of the stem, leaves, flowers, and fruit, and it will be found on examination, that all the common well-known plants just mentioned have the same kind of stems, the same reticulation of veins in the leaves, and have also complete flowers, with sepals, petals, stamens and pistil, each growing separate and distinct, and, therefore, they are all, so far, really the same kind of plants.

But though the buttercup, poppy, water lily, wallflower, violet, flax, lime tree and orange tree, all agree so far in the structure of the stem, leaves, and flowers, they also differ from each other in some respects. Thus the buttercup has numerous stamens and also numerous carpels, while the poppy has also numerous stamens, but apparently only one carpel. Again, the violet has five stamens and three carpels, while the lime tree has numerous stamens and five carpels.

Another difference is the way in which the seeds are arranged in the **ovules**. In some they adhere to the sides, in some to the centre, with many minor differ-

ences. Thus, in an orange the seeds are in the centre of the fruit, in the poppy the seeds adhere to the sides of the divisions of the ovary, and in the violet they adhere more nearly to the sides of the ovary itself.

The character of the fruit is another point of difference between plants. The buttercup, poppy, and flax, have each a dry hard fruit, in which the seeds hang loosely, while in the orange the fruit is succulent or juicy, with the seeds imbedded in the soft substance of the orange.

The group **thalamifloræ**, like the other groups, is divided into smaller groups, called **orders**, according to these differences in the structure of the flower and nature of the fruit. The chief of this order are given in Plate XIII. In reading the description of these it must be borne in mind that no reference is made to the stem or root, or to the veining of the leaves, or to the seed-leaves in the seed, for the reason that in this respect they all agree in having the characteristics of **exogens**, that is, they have roots which are the radicle itself extended, the structure of the stem is regular, with central pith and external bark, the leaves have veins in network and the seeds have two seed-leaves.

A buttercup belongs to the **thalamifloræ** because it has the flower completely developed, *i.e.* the sepals, petals, stamens, and pistils growing quite distinct from each other; also it belongs to the order **Ranunculaceæ**, because it agrees with the plants belonging to that order in having no stipules, in having the petals of the corolla lapping over each other at the edges (which is described by the single word **imbricated**), in having the carpels of the pistil distinct, and the seeds without any **aril** or covering to them.

This flower, the buttercup, is taken as a specimen, or type, of the order **Ranunculaceæ** because it presents, tolerably clearly, these characters of no stipules, imbricated corolla, distinct carpels, and seeds without **aril**. Other plants of the order have the same characters, but not all so clearly developed.

The buttercup is a small herb with stem erect and hairy, the leaves are **trifid**, or cut into three **lobes**, the lobes being again trifid; but the leaves towards the upper part of the plant are only once **trifid**, the **lobes** of these being narrow (or linear) and entire. The **peduncle**, or flower-stalk, is rounded; the **calyx** spreads outwards; the **petals** have a small scale, or cup, at the base of each, and lap over at the edges.

In addition to these characters, which are of comparatively little importance, are others, which, for purposes of classification, are of greater importance. It has five sepals, five petals, numerous stamens and carpels. The sepals of the calyx are quite distinct from each other, so are the petals of the corolla. The sepals and petals grow from below the carpels, so also do the stamens, and none of these adhere to any other. These characters mark it as belonging to the **Thalamifloral** group; and in describing it in full it would be quite sufficient to say that it belonged to that group, without any further description of the relative position of the parts of the flower.

So, further, it has the root, pithy stem, veined leaves, four or five parted flowers, and **di-cotyledonous** seeds of an **exogen**, but in describing it all this would be sufficiently expressed by saying that it was an **exogen.**

This is the great purpose of classifying plants: by putting them in groups having similar characters, a plant can be described in comparatively few words; and also a new plant can have a place readily found for it by observing the characters of it, and placing it in the group to which it naturally belongs.

§ 68. The order **Ranunculaceæ** contains the plants which agree in having no stipules, imbricated corolla, numerous stamens, very small (or minute) embryo, seeds without any covering within the ovary, and containing albumen. In addition to this combination of characters (which is peculiar to the order of Ranunculaceæ) all plants belonging to the order **Ranunculaceæ** possess also the general characters of exogens and of Thalamiflorals.

The subdivisions of an order are called **genera.** The genera of the order of Ranunculaceæ are:—

1. **Clemateæ,** specimen the clematis.
2. **Anemoneæ,** „ „ anemone.
3. **Ranunculus,** „ „ buttercup.
4. **Helleboreæ,** „ „ hellebore and aconite.
5. **Actaceæ,** „ „ baneberry.

And others.

The type of this order is the **buttercup** (*Ranunculus acris*) which has already been fully described. The plants of the order Ranunculaceæ are all, more or less, acrid and poisonous. Some of them, the hellebore and aconite, extremely so.

§ 69. The order **Papaveraceæ** contains the plants agreeing in having the carpels consolidated, the calyx deciduous or falling off early, and the seeds growing to the walls of the ovary, or, as it is called, parietal.

The best specimens of this order is the common **poppy** (*Papaver Rhœas*). This possesses the characters already given as distinctive of the order. It is a herb growing wild in cornfields, with long stem and four bright red petals. The fruit is a capsule, or little box, with one cell containing very many seeds. The stigmas form a kind of lid to the fruit, from under which the seeds, when ripe, escape. The leaves are pinnatifid.

Another plant of this order is the **celandine,** which has also two sepals, deciduous, and four petals, yellow; but the fruit, instead of being a capsule, or little box, is a long pod, somewhat resembling a pea or bean, while the flowers, instead of being solitary, as in the poppy, are arranged in small umbrels.

All the plants of this order are narcotic; that is, their juice causes sleep. Opium is made from it.

The difference between the two orders to which the buttercup and poppy respectively belong is not very great, and with one of the less clearly marked specimens of either, some difficulty might be found in telling to which it really belonged; but the narcotic and milky properties of the juice of poppies will always be found a distinctive mark.

§ 70. The order **Nymphaceæ** comprises all the plants agreeing in having numerous stamens, the carpels united into a fruit with many cells, with dissepimental adhesion of seeds; also the seeds have either much albumen, or, if none, a very large plumule. This last is the great distinguishing feature of the order, which otherwise is very similar to Ranunculaceæ.

The type of this order is the **water lily** (*Nymphæ alba*), a floating plant, with pithy stem full of air cavities, four sepals, petals and stamens numerous, both apparently, but not in reality, growing from above the ovary; the filaments of the stamen are leafy or petaloid; the fruit has many cells, each containing many seeds.

The leaves are cordate and very large, sometimes eight feet wide or more, and the flowers large, about twelve inches across and very beautiful, having numerous white oblong petals and yellow stamens. In this plant may be seen the gradual change of petals into stamens, and of sepals into petals, which has been spoken of in the general description of the different parts of plants.

This plant is also one of the examples that the grouping of plants in families, orders, &c., is not to be made with absolute certainty. The root of the water lily grows in a manner both exogenous and endogenous; the root grows from within the radicle, as in an endogen, but with two seed leaves, as in an exogen. Other peculiarities also exhibit themselves in this plant, which is generally *classed* with the Thalamifloral exogens, but some botanists assert its claims to a place in the class of endogens. The **lotus** is another plant of the order Nymphaceæ.

§ 71. The order **Cruciferæ** comprises all the plants agreeing in having six stamens (two longer than the other standing by themselves, and four shorter standing in pairs beside the pistil), four sepals and petals, the seeds attached to the sides of the ovary.

The type of this order is the common **wallflower** (*cheiranthus cheiri*), a small herb with alternate leaves lanceolate in shape, racemose flower, with four sepals, four petals, six stamens, two carpels, contaning several seeds, without albumen, attached to the sides of the ovary: fruit a silique.

Most of the plants of this order are remarkable for the arrangement of the stamens, the peculiarity of which is that there appears to be a double row of stamens, four short and four long ones, but that only two of the outer row of four long are ever present, the others being abortive.

Other plants of this order are **turnips, radish, horse-radish, mustard, watercress**, and **cabbages.** All the plants belonging to Cruciferæ are wholesome, and some especially so.

§ 72. The order **Violaceæ** comprises all plants having the calyx and petals each four, five, or more parted, the anthers of the stamens crested and turned inwards, the fruit consolidated, the seeds attached to the sides of the ovary, and the embryo straight.

The type of this order is the **sweet violet** (*viola odorata*), a small herb with alternate leaves and stipules, small flowers with beautifully coloured petals of unequal size, the larger having a spur, that is extending further back than the flower stalk.

Other plants of this order are the **pansy**, the **marsh-violet**, the **dog violet**, and some others, including one South American species from the root of which ipecacuanha is procured.

§ 73. The order **Linaceæ** comprises all the plants having symmetrical flowers, with the calyx intricate or overlapping, the corolla twisted, seeds albuminous.

The type of this order is the common **flax** (*linum usitatissimum*) a tall herb with slender stem, narrow alternate leaves, and small blue flowers, with five sepals, five petals, five stamens, and five carpels. Beside the five perfect stamens there are also five others less partially developed, making really ten, while the fruit, a capsule, contains five cells, each nearly divided into two, so as to look as if with ten cells.

From the word **linum**, meaning a thread, are derived our common words **linen**, **linseed**, and **lint**. The flax plant has always been cultivated from the fitness of its stem fibres to make strong threads, which, woven, make linen. This material, composed of woody tissue, is infinitely stronger than cotton, which is composed entirely of cellular tissue. **Linseed oil** is pressed out of the seed of the linaceæ; the seeds, when the oil is drained off, makes **oilcake** for feeding cattle.

§ 74. The order **Tiliaceæ** comprises all the plants agreeing in having a calyx, not overlapping, a corolla, either overlapping or twisted, numerous stamens, seeds with albumen and straight embryos.

The type of the order is the common **lime tree** (*tilia Europa*), having light-green coloured, heart-shaped leaves, flowers of bright yellow and green growing from the axils of the leaf, with a leafy bract growing to the peduncle for half its length. The fruit is a capsule.

The wood of this tree is much used for carving, being pretty, easy to work, and durable. The bark is used to make rough mats. **Jute is obtained from a plant of this order.**

§ 75. **Aurenticaceæ** is an order comprising plants having symmetrical flowers, with petals overlapping, dotted leaves, consolidated juicy fruit, but little, if any, albumen.

The type of this order is the common **orange tree.** The eatable orange is the fruit, with the seeds in the axils of the placentæ, or partitions of the ovary, and with a leathery rind.

The wood of this tree is of great use for ornament, being hard and compact, and the flowers are very beautiful and fragrant. Other plants of this order are the **lemon, citron, lime, shaddock**, &c.

CALYCIFLORÆ.

§ 76. The order **Rosacea** comprises plants agreeing in having four or five sepals and petals, numerous stamens, distinct carpels, numerous, and leaves with stipules.

The type of this order is the common **wild rose.**

The order **Rosacea** is very important, very extensive, and very varied; so varied that it is convenient to divide it into groups. The general division is into four groups:—

Rosa (type **blackberry**), comprising roses, cinquefoils, strawberries.

Pomeæ (type **apple**), comprising apple, pear, medlar, quince.

Amygdaleæ (type **cherry**), comprising cherry, peach, nectarine, plum, apricot.

Sanguisorbeæ (type **burnet sanguisorb**), comprising wild flowers not so well known.

The genus **Rosa** comprises the roses proper, generally with alternate leaves, calyx adhering to the ovary, five-parted with fleshy tube, five petals, numerous stamens attached to calyx and also to corolla, fruit dry achenes. The rose proper has only five petals. The beautiful flower of the cultivated rose has numerous petals, which it obtains by becoming double, that is, many of the stamens revert to the form of petals. Roses grow in any part of the world north of the equator, but not south of it.

The **cinquefoil**, generally a creeping plant with yellow flower, is found in Northern Europe. The root is useful for medicine, and in some places among the northern islands is used as food.

The **fragaria** or **strawberry**, is one of the most agreeable fruits England possesses. The plant bearing it is a creeper, throwing out new roots at the joints of the

PLATE XIV.

CLASS EXOGENS. SUB-CLASS CALYCIFLORÆ.

ORDERS.	CHIEF GENERA. (Subdivision of Orders.)	SPECIMEN.
LEGUMINOSÆ. *Peas, Beans and Clover.* Trees, shrubs and herbs, very various, growing in all climates.	*Faba*	common bean.
	Phaseolus	kidney bean.
	Vicia	vetch or tares
	Pisum	pea.
	Trifolium	clover.
	Ulex	gorse or furze.
	Tamarindus	tamarind tree.
	Acacia	acacia tree.
ROSACEÆ. *Roses, Apples, Cherries and Plums.* Trees, generally in orchards, but also growing wild.	*Rosacea* } *Rosa*	common rose, dog rose, moss rose.
	Potentilla	cinquefoil.
	Fragaria	strawberry.
	Amygdalus } *Pyrus*	apple, pear.
	Amygdalus	almond, peach.
	Prunus	apricot, plum.
	Cerasus	cherry, laurel.
	Sanguisorbeæ	burnet, sanguisorb.
CUCURBITACEÆ. *Melon, Gourd, Cucumber.* Generally climbing plants.	*Cucumis*	melon, cucumber, gourd.
	Cucurbita	pumpkin, bottle gourd, vegetable marrow.
	Bryony	wild bryony.
	Momordica	squirting cucumber.
GROSSULAREÆ. *Currants, Gooseberries.* Shrubs, often prickly.	*Ribes,* in four groups } *Grossularia*	gooseberries.
	Botrycarpum	prickly gooseberries.
	Ribesia	currants.
	Symphocalyx	golden flowered currant.
UMBELLIFERÆ. *Carrot, Parsnip, Hemlock.* Generally herbs, rarely shrubs.	*Heracleum*	cow parsnip.
	Petroselinum	parsley.
	Pastinaca	parsnip.
	Conium	hemlock.
	Daucus	carrot.
	Fœniculum	fennel.

PLATE XIV.—*continued.*

CLASS EXOGENS. SUB-CLASS CALYCIFLORÆ.

ORDERS.	CHIEF GENERA. (Subdivision of Orders.)		SPECIMENS.
LORANTHEÆ. *Mistletoe.* Parasitic plants.		*Loranthus*	mistletoe.
CRASSULACEÆ. *Houseleeks.* Succulent plants, herbs or shrubs.		*Sedum*	stonecrop
		Sempervivum...........	house leek.
COMPOSITÆ. *Sunflower, Daisy, Dandelion, Lettuce.* Plants or shrubs, having the flowers small and collected, in dense heads, surrounded by an involucre.	*Corymbiferæ*	*Jussilago* ...	coltsfoot, daisy.
		Helianthus	sunflower.
		Senecio	groundsel.
	Cynaraceæ...	*Cynara*...	artichoke.
	Cichoraceæ	*Taraxacum*	dandelion.
		Cichorium ...	endive.
		Lactuca......	lettuce.

stem, with trifid leaves, tubular calyx ten-parted, and five petals in corolla. The stamens and carpels are numerous. The fruit is formed by the carpels and the receptacle together; the latter becomes fleshy and succulent, surrounded by the ripe carpels, which are juicy and succulent. Many of the species of the genus fragaria are cultivated in our gardens for the fruit; two of the chief species are **fragaria semperflorens** and **fragaria elatior.**

These genera, the **rosa**, **cinquefoil**, and **fragaria**, together with that of **rubus**, (containing the **raspberry**, (*rubus idæus*), and the **blackberry** or **bramble**, (*rubus fruticosus*), are the chief of the **rosa** subdivision of the order **Rosacea.**

The next subdivision **pomeæ**, has only the genus **pyrus.** Most of the plants belonging to it are trees, and natives of Britain.

The **apple** and **pear** both belong to this group, and to the genus pyrus. The **apple** tree (*pyrus malus*) differs from the **pear** tree (*pyrus communis*) chiefly in the shape of the fruit, the one being more globular than the other. There are many other trees of this genus, but none bear such agreeable fruit, though their fruit is more or less eatable.

The group **amygdaleæ**, comprise the **almond** (*amygdalus communis*), the **peach** (*amygdalus Persica*); the **laurel** (*cerasus laurocerasus*); the **cherry** (*cerasus communis*); the **apricot** (*prunus Armeniaca*); and the **plum** (*prunus domestica*).

The remaining division of the order Rosacea is that of **sanguisorbeæ**, an apetalous group of plants with single carpels. They are chiefly wild plants, some of use medicinally, growing in most parts of the old world.

The leaves and seeds of this order (Rosacea), are more or less poisonous from the presence of prussic acid, but the fruits themselves, without the seeds, are more or less edible, and many of them very wholesome and agreeable.

The oil of bitter almonds is a very active poison, while from the petals of sweet roses is made the otto of roses, a costly perfume, rendered expensive from the very great number of leaves required to produce even a small quantity of the scent.

§ 77. The order of **Leguminoseæ** comprises plants having flowers with the stamen adhering to the calyx, and the seeds attached to the ovary at the joining of the carpel.

This order contains all the plants having what are called papilionaceous flowers, that is, flowers whose petals from their shape and gay colours somewhat resemble a butterfly. Others have the fruit in legumes, or long pods. One or other of these is characteristic of every genus in this order.

The order **Leguminoseæ** divides itself into two great groups, only one of which is found in Britain.

The British group is called **Papilionaceous**, from its having the irregular butterfly kind of flowers just spoken of. The flower has five petals, of which the lower and smaller two are close together, in the manner of the keel of a boat. Two others stand straight up, while the fifth, larger in size, covers over the whole. The stamens, pistil, &c., are in the lower part of the flower between the two smallest petals.

The type of this group of leguminoseæ is the common **garden pea** (*Pisum sativum*). In this group are the peas, beans, vetches, clover, gorge, &c., most of which are useful for food, either for men or for cattle.

The other group, found chiefly in America and Australia, has more regular flowers, and contains the **tamarind** and **acacia** trees. The type of the group is the **broad-winged acacia** (*Acacia platyptera*). From the secretions of the trees of this group are obtained **senna, liquorice**, various **gums**, &c. The timber of the trees of this order is also various and useful. The **rosewood, locust, laburnum, ebony**, and **tamarind**, are all timber trees of this order.

Also it yields numerous dyes, as **indigo, logwood, sappan wood**, and **Brazil wood**, &c.

§ 78. The order **Cucurbitaceæ** comprises plants agreeing in having a monopetalous corolla, superior calyx, one-celled ovary, with parietal placentæ, and numerous seeds, in unisexual flowers.

The principal genera are **Cucumis, Cucumita, Bryonia,** and **Momordica.**

The type of this order is the Common **Bryony** (*Bryonia dioica.*

The genus **Cucumis** contains the **cucumber, melon, water melon,** and **gourd,** originally tropical plants, generally climbing with large succulent fruit, having firm outer layers.

The genus **Cucurbita** contains the **Bottle Gourd, Pumpkin, Vegetable marrow,** and some others, similar.

The genus **Bryonia** contains wild hedge-plants, with bitter fruit, often poisonous, including the **wild Bryony.**

The genus **Momordica** contains the **squirting cucumber,** (*Melaterium*) which, when ripe, opens with some force, and throws the seeds to some little distance.

§ 79. The order **Grossulareæ** comprises plants agreeing in having distinct petals, inferior ovary carpels united, into one cell, parietal placenta, fruit a berry.

The plants of this order are generally shrubs, with green flowers, small, occasionally with prickly stem. The type is a **gooseberry** (*Ribes grossularia*).

The order has only one genus, **Ribes,** which is divided into four groups, **Grossularia,** containing **gooseberries; Botrycarpum,** plants between gooseberries and currants; **Ribesia** containing **currants;** and **Symphocalyx,** ornamental shrubs only.

§ 80. The order **Umbelliferæ** contains plants agreeing in having their flowers in umbels, fruit inferior, splitting into two equal halves, each half one carpel.

The type of this order is the **Cow parsnip** (*Heracleum Sphondylium*).

The principal genera are **Heracleum, wild parsnips,** growing in hedgerows, &c.; **Petroselinum, parsley,** now grown in gardens, but growing wild on rocks, whence its name of **Petro** (rock) **selinum** (parsley), or rock parsley; **Pastinaca, parsnips**, cultivated for the edible roots; **Conium, hemlock**, a deadly poison; **Daucus, carrot**, like parsnips, with an edible root; **Fœniculum, fennel.**

This order is very distinct, from its flowers all springing from one point in the stem, and its inferior ovary splitting into two carpels, which remain suspended on either side of the peduncle.

§ 81. The order **Crassulaceæ** contains plants agreeing with each other in having distinct petals, calyx free from ovary, leaves without stipules, and distinct carpels.

The type of the order is the **stone crop** (*Sedum acre*).

The order is distinguished by the leaves, and some other parts of the plant, being succulent.

§ 82. The order **Loranthaceæ** comprises plants having the calyx adhering to the ovary, no corolla, the embryo minute, with abundant albumen.

The type of this order is the common **mistletoe** (*Viscum album*), a parasite (that is, a plant that does not grow by itself, but upon another plant, generally a tree). The mistletoe lives chiefly upon trees, sometimes upon the oak, deriving its food from the sap in the body of the tree, under the bark of which it fixes its roots.

The leaves are opposite and thick (or fleshy.) The flowers are small and of two kinds, barren and fertile, having no corolla, and the calyx adhering to the ovary. The fruit is a berry, either succulent or dry, and does not begin to grow until three months after the pollen of the stamens has been poured out and entered the pistil. Occasionally, two embryos of the mistletoe adhere, so that the same seed has two growing points.

§ 83. The order **Compositæ** contains plants with monopetalous tubular corolla, superior calyx, flowers in heads, fruit dry, one-celled, seed single.

The type of the order is **Dandelion** (*Taraxacum Deus-leonis*).

This order is a very distinctly marked and very large

PLATE XV.

CLASS **EXOGENS.** SUB-CLASS COROLLIFLORÆ.

ORDERS.	CHIEF GENERA. (Subdivision of Orders.)	SPECIMENS.
BORAGINEÆ. *Borages.* Herbs and shrubs; gardens and waysides.	*Myosotis*	forget-me-not.
	Borago	borage.
	Cynoglossum	hound's tongue.
PRIMULACEÆ. *Primroses and Cowslips* Herbs growing in fields and gardens.	*Primula*	primrose, cowslip, oxlip.
	Anagallis	pimpernel.
	Cyclamen	sow bread.
	Lysimacha	moneywort.
CONVOLVULACEÆ. *Bindweed.* Twining herbs in gardens and hedges.	*Convolvulus*	lesser convolvulus. convolvulus tricolor.
	Calystegia	great bindweed. sea bindweed.
OLEACEÆ. Shrubs and trees; fields and hedges.	*Olea*	olive.
	Syringa	lilac.
	Jasminium	privet.
	Fraxinus	ash.
GENTINEÆ. *Gentians.* Herbs in gardens and pastures.	*Gentiana*	common gentian.
	Chlora	yellow wort.
	Erythracea	centaury.
	Menyanthes	buckbean.
SOLONACEÆ. *Potatoe, Tobacco.* Herbs or shrubs; gardens and waste places.	*Atropa*	deadly nightshade, mandrake.
	Datura	thorn apple.
	Hyoscyamus	henbane.
	Nicotiana	tobacco.
	Solanum	potatoe, egg plant.
LABIATÆ. *Useful Herbs.* Herbs, or small shrubs; hedges and ditches.	*Lamium*	dead nettle.
	Lavandula	lavender.
	Marrubium	horehound.
	Mentha	peppermint, penny royal.
	Nepeta	ground ivy.
	Rosmarinus	rosemary.
	Salvia	sage.
	Thymus	thyme.
SCROPHULARIACEÆ *Foxglove, Snapdragon.* Herbs and shrubs, growing anywhere.	*Digitalis*	foxglove.
	Euphrasia	eye-bright.
	Antirrhinum	snapdragon.
	Linaria	toadflax.
	Veronica	speedwell.
	Corobanohe	broomrape.

one. All the plants have their flowers in heads, looking like compound flowers.

The order is divided into three tribes, **Corymbiferæ**, having tubular florets, and soft involucres; **Cynaraceæ**, with tubular florets, and spiny involucres, and **Cichoraceæ**, with the florets ligulate.

Besides the plants mentioned the order comprises **Butterbua, Southernwood, Chamomile, Burdock, Hawkweed, Tansy,** and **Sow thistle.**

COROLLIFLORÆ.

§ 84. The order **Boragineæ** comprises plants agreeing in having regular monopetalous flowers, alternate leaves, and ovary divided externally into four lobes, with single style.

The type of the order is the **forget-me-not** (*Myosotis palustris*), a small herb with alternate leaves and little blue flowers arranged in cymes.

The principal genera are **Myosotis**, containing the pretty **forget-me-not** and **mouse-ear**; the **Borago**, containing the common **borage**; and **Cynoglossum**, containing the **houndstongue** and other plants; all rather coarse with small flowers. Roughness is a general characteristic of the Borogineæ.

§ 85. The order **Primulaceæ** comprises plants having regular monopetalous flowers, with the stamens opposite the petals, and fruit a superior capsule with placenta free in centre.

The type of the order is the **common primrose** (*Primula vulgaris*), a small herb with pale yellow flowers on slight stems.

The chief genera are **Primula**, containing the **primrose, cowslip, oxslip,** &c.; **Anoxallis**, containing the **pimpernel**, or, **poor man's weather glass**, having flat wheel-shaped corolla, and capsule with lid like a box; **Cyclamen**, containing the common **cyclamen**, called **sowbread**, from hogs feeding on it; and **Lysimachus**, containing **money wort.**

The characteristic of **Primulaceæ** is to have monopetalous flowers with one style, and the stamens opposite the petals.

§ 86. The order **Convolvulaceæ** contains plants with monopetalous, bell-shaped flowers, calyx generally imbricated, and stems generally twining.

The type of the order is the **bindweed** (*Convolvulus arvensis*), a twining creeper, with alternate leaves and spreading flowers growing in axils of leaves.

The chief genera of the order are **Convolvulus**, containing the lesser and the tricolor **Convolvulus**; and also the **Scammony**, from which a useful drug is obtained, and **Calystegia**, containing the **great bindweed**, and the **sea bindweed**.

The **dodder** plants are sometimes considered to belong to the order **Convolvulaceæ**, but their corolla is imbricate instead of monopetalous.

§ 87. The order **Oleaceæ** contains plants having monopetalous flowers, two stamens, and superior two-celled ovary.

A type of the order is the **olive** (*Olea Europeæ*), a tree with two-coloured leaves, and greenish flower growing in racemes from the axil.

The chief genera of the order are **Olea**, containing the **olive**; **Syringa**, the **lilacs**; **Jasminium**, the **privet**; and **Fraxinus**, the ashes.

The **ash** is one of the most prominent plants of the order, but not a typical one, owing to its flowers having generally no calyx or corolla; but the general structure of the plant and of its fruit shews it to belong to the order Oleaceæ; and the **flowering ashes** shew some sign of a corolla.

§ 88. The order **Gentineæ**, contains plants having opposite ribbed leaves, regular flowers, calyx in a whorl, stamens of equal length, two carpels with parietal placentæ.

The type of the order is **autumn gentian** (*Gentiana amarella*), a small plant with many purple flowers.

The chief genera are **Gentiana**, containing **gentian**;

Chlora, containing **yellow-wort**; **Erythracea**, containing **centaury**; and **Menyanthes** containing **buckbean.** Many species of these genera are used in medicine.

§ 89. The order **Solonaceæ**, or **Nightshades**, contains plants generally poisonous, having alternate leaves, monopetalous corolla, inferior calyx, two-celled ovary, and fruit either a capsule or berry, and axile placentæ.

The type of the order is the **Bittersweet Solanum** (*Solanum dulcamara*), a shrub with bright red poisonous berries in cymose clusters of purple flowers.

The chief genera of this order are **Atropa**, containing the **deadly nightshade** and **mandrake**, plants easily known by their regular bell-shaped corolla and succulent fruit; **Datura**, with large funnel shaped corolla, and four-celled capsule, containing the **thorn apple** or **stramonium**; **Hyoscyamus** with irregular corolla and capsule opening by a transverse lid, containing **henbane**; **Nicotiana**, generally herbs with five-parted flowers and two celled capsules, containing the various species of **tobacco** plants; and **Solanum**, herbs or shrubs with entire leaves, rotate corolla and fruit a berry, containing the common **potatoe, garden nightshade, bittersweet** and **egg plant**.

§ 90. The order **Labiatæ** comprises plants having square stem, irregular corolla, four-lobed ovary, in nearly sessile flowers arranged in axillary cymes.

The type of the order is the **deadnettle**, or **white lamium** (*Lamium alba*), a coarse herb with square stem, opposite leaves and white flowers in axillary cymes.

The chief genera of the order are **Lamium**, containing **deadnettle**; **Lavandula**, or **lavender**; **Marrubium**, or **horehound**; **Mentha**, or **peppermint**; **Napeta**, or **ground ivy**; **Rosmarinus**, or **rosemary**; **Salvia**, or **sage**; and **Thymus** or **thyme**; all well known domestic herbs.

§ 91. The order **Scrophulariaceæ** comprises plants having leaves with no stipules, inferior calyx, irregular corolla, two-celled ovary and capsular fruit.

The type of the order is **Toadflax**, or **common linaria**

(*Linaria vulgaris*) ; herb with narrow alternate leaves and irregular yellow flowers in a terminal raceme.

MONOCHLAMYDEÆ.

§ 92. The order **Polygonaceæ** contains plants that are herbs or shrubs, with alternate leaves, flowers sometimes unisexual, inferior calyx, stamens on the calyx, fruit a triangular nut.

The type of the order is the **Bistort polygonum** (*Polygonum bistorte*); herb with radical leaves, and pale pink flowers in terminal spikes on simple stems.

The chief genera are **Polygonum** containing **buckwheat, knot grass**; and **Rumex** containing **dock sorrel**, &c.

§ 93. The order **Urticaceæ**, contains plants that are trees, shrubs, or herbs, with alternate leaves, generally covered with stinging hairs ; fruit a simple nut.

The type of the order is the small or garden **nettle** (*Urtica urens*), a small herb, with opposite leaves and small flowers in axillary clusters or spikes.

The chief genera are **Urtica**, containing the smaller and larger **stinging nettle** and the **Roman nettle** ; **Cannabis**, containing **hemp** ; **Humulus**, containing the **hop plant** ; **Ficus**, containing the **fig tree**; and **Morus**, containing the **mulberry tree**.

Cannabis sativa, the common **hemp**, is remarkable for its tough fibres, from which linen cords, &c., are made. **Ficus carica**, the **eatable fig**, is an example of how much parts of plants sometimes look like what they are not, or do not look like what they are. A common fig is not a fruit, but the receptacle of many fruits. Just as in a strawberry, the real fruits are small achenia upon a succulent receptacle, so the real fruits of a fig are the small projections *within* the succulent receptacle, to which the name of fig is given. The receptacle in growing closes over the flowers, leaving but a narrow opening at the top ; so that the fruit is really the receptacle having on its inner surface numerous small flowers containing seeds.

PLATE XVI.

CLASS EXOGENS. SUB-CLASS MONOCLAMYDEÆ.

ORDERS.	CHIEF GENERA. (Subdivision of Orders.)	SPECIMENS.
POLYGONACEÆ. *Buckwheats.* Herbs, in gardens and fields.	*Rumex*	buckwheat, knotgrass.
	Polygonum	dock, sorrel.
URTICACEÆ. *Nettles.* Herbs, shrubs and trees; gardens and hedges.	*Urtica*	nettles.
	Cannabis	hemp.
	Humulus	hop.
	Ficus	figs.
	Morus	mulberry tree.
CORYLACEÆ. *Oak, beech, hazel, and chestnut trees.* Trees and shrubs; woods and plantations.	*Castanea*	chestnut.
	Fagus	beech.
	Quercus	oak.
	Corylus	hazel.
	Carpinus	hornbeam.
SALICACEÆ. *Sallows, osiers, and willows.* Shrubs and trees; woods and hedges.	*Salix*	sallow, osiers, and willows.
	Populus	poplar tree, aspen tree
BETULACEÆ. *Alder and birch trees.* Shrubs and trees; woods and marshes.	*Alnus*	alder trees.
	Betula	birch trees.
ULMACEÆ. *Elm trees.* Shrubs or trees; woods.	*Ulmus*	elm tree.
PINACEÆ or CONIFERÆ. *Pine and fir trees.* Shrubs or trees; woods and plantations.	*Taxus*	yew tree.
	Cupressus	cypress tree.
	Pinus	pine tree.
	Abies	fir tree.
	Juniperus	juniper bush.
LAURACEÆ. *Aromatic plants.* Trees; woods and plantations.	*Camphora*	camphor laurel.
	Cinnamomum	cinnamon tree.
	Laurus	sweet bay.
	Nectandra	pichurim bean.
	Sassafras	sassafras laurel.

The common **hop** (*Humulus lupulus*) is used very largely in beer for its bitter aromatic and astringent properties. The genus **Morus** contains the **white mulberry** (*Morus alba*) upon the leaves of which the silkworm feed.

§ 94. The order **Corylaceæ** contains plants being trees with stipulate leaves, unisexual flowers, inferior ovary, partly enclosed in a leathery cup or husk; fruit, a bony or leathery nut, one-celled, also partly enclosed. Flowers with stamens in catkins, flowers with pistlls in clusters somewhat resembling buds.

The type of the order is the common **Hazel** (*Corylus avellana*) a small tree, with flowers of two kinds (one with stamen, and the other with pistil) the stamen flowers in catkins, and alternate leaves; fruit a nut.

The chief genera are **Castanea**, or **chestnut**; **Fagus**, or **beech**; **Corylus**, or **hazel**; **Quercus**, or **oak**; **Carpinus**, or **hornbeam.**

The common **hazel** (*Corylus avellana*), the common stock of most varieties of cultivated nuts and filberts, growing in every part of Britain, is cultivated for its nuts. The **sweet chestnut**, (*Castanea versa* or *vulgaris*) is a different tree from the **horse chestnut**, the seeds of it being good and pleasant to eat. The **beech tree** has many varieties, white, purple, and copper-coloured; the cut leaved and curl leaved; the oblique leaved, the evergreen, &c., &c., &c., all producing durable timber, suitable especially for work under water. The **hornbean tree** (*Carpinus betulus*) somewhat resembles the beech in appearance, but its stem is not so smooth, nor its leaves so shining.

The **Oaks** (*Quercus*) are amongst the noblest of English trees. The common **oak**, (*Quercus pedunculata*), and the **sessile cupped oak** (*Quercus sessiliflora*) are the most generally grown. The wood is greatly valued for its durability, and the fruits, acorns, are a favourite food for pigs, &c. Besides those, there is another variety of the oak, called evergreen oak, among which are the **Cork tree** (*Quercus suber*) the bark of which is cork; the **beech**

oak (*Quercus faginea*) and the **Holm oak** (*Quercus ilex*) with many others.

§ 95. The order **Salicaceæ** contains trees or shrubs, with alternate flowers, flowers of two kinds in catkins, and many-seeded coriaceous fruit, with hairy seeds.

The type of the order is the **Sallow willow** or **goat willow** (*Salix caprea*) a small tree with yellow flowers in oval catkins.

The two genera of the order are **Salix** and **Populus**, containing, the one, **sallows**, **osiers**, and **willows**; and the others **poplars**. The plants of the **Salix** are cultivated for their toughness and flexibility, being much used in making hoops, handles, baskets; their bark, also, is used for medicine and for tanning. The **poplar** trees are tall and of rapid and straight growth: they are of use for the length and straightness of their timber, and their appearance is also very ornamental.

§ 96. The order **Betulaceæ** contains trees and shrubs with flowers of two kinds in catkins, with fruit two-celled, one-seeded, and flat.

The type of the order is the common **birch** (*Betula alba*) a tree with erect branches, ovate serrated leaves, and pendulous catkins.

The two genera of the order are **Betula, birches**, and **Alnus, alders.** The birch trees are very useful in their bark, leaves, &c., to the tanner and dyer. The varieties are numerous. The common weeping, paper, American, and red birch are the most common. The alders generally grow near water; its bark is useful for tanning, and its wood makes good charcoal for gunpowder.

§ 97. The order **Ulmaceæ** contains **elm trees**, differing from many of the trees in Monochlamydeæ in having only one kind of flower, containing both stamen and pistil, with divided bell-like calyx, free from ovary. The fruit, a samara, that is, being winged.

The type of the order is the **Wych elm** (*Ulmus montana*).

The wood of the elm is remarkably tough and durable,

PLATE XVII.

CLASS ENDOGENS.

ORDERS.	CHIEF GENERA. (Subdivisions of Orders).	SPECIMENS.
PALMACEÆ. *Cocoa nut, date, and wax palms.* Trees, generally growing near water.	*Borassus*	palmyra palm.
	Calamus	cane palm.
	Cocos	cocoa nut palm.
	Corypha	talipat palm.
	Ceroxylon	wax palm.
	Phœnix	date palm.
LILIACEÆ. *Lilies, tulips, onions, &c.* Bulbous herbs in gardens and meadows.	*Lilium*	lilies.
	Tulipa	wild tulip.
	Allium	onion, garlic, &c.
	Asparagus	asparagus.
	Convallaria	lily of valley.
ORCHIDACEÆ. *Orchis, helleborine.* Herbs; gardens and pastures.	*Epipactus*	helleborine.
	Neottia	bird's nest orchis.
	Orchis	spotted orchis.
	Ophry	fly, spider, and bee orchis.
	Platanthera	butterfly orchis.
IRIDEÆ. *Crocuses and flags.* Herbs, in gardens and marshes.	*Iris*	blue flag, yellow flag.
	Crocus	crocuses.
JUNCACEÆ. *Rushes.* Herbs, on wet and cold land.	*Juncus*	soft rush, common rush.
CYPERACEÆ. *Sedges.* Herbs, near ponds and wet places.	*Carex*	sandy sedge.
	Eriophorum	cotton grasses.
	Scirpus	bullrush.
GRAMINACEÆ. *Grasses.* Herbs; corn-fields, meadows, &c.	*Anthoxanthum*	sweet vernal grass.
	Avena	oats.
	Festuca	meadow foxtail grass.
	Hordeum	barley.
	Secale	rye.
	Oryza	rice.
	Phragmites	reeds.
	Poa	meadow grass.
	Triticum	wheat.

and is, therefore, used for work liable to damp, and especially for coffins. When polished, the wood has a good appearance. The bark is much used for medicine.

§ 98. The order **Pinacea**, often called **Coniferea**, comprises a great variety of trees, all, however, agreeing in being trees or shrubs with hard leaves, and resinous wood. The leaves are generally very narrow, hard, and veinless; the flowers in cones of two sorts: the fruit in scaly cones enclosing naked seeds.

The type of the order is **Scotch fir**, (*Pinus sylvestris*).

Yew trees are low, spreading, long lived, and of slow growth, generally found in churchyards. The **Cypress**, a tree with scaly leaves, and very small seeds, is also much found in churchyards and cemeteries. The **pine trees** have three, four, or five narrow, needleshaped leaves growing together. The appearance of the trees is very beautiful, and the pine wood is the most extensively used of any, on account of its being soft and easily worked. There is a great number of varieties of pine.

§ 99. The order **Lauraceæ** consists of trees and shrubs, mostly aromatic and living in warm climates. Flowers with no corolla, and imbricated calyx. The only English type is **Sweet bay** (*Laurus nobilis*).

The genera of this order are **Camphora**, from the plants of which **camphor** is obtained; **Cinnamomum**, from the barks of which **cinnamon** and **cassia** are taken; **Laurus**, the type of the order, and **Sassafras**, the bark of which is useful in medicine.

ENDOGENS.

§ 100. The order **Palmaceæ** contains a **variety** of plant of peculiar appearance, generally **trees**, with tall stems, most cylindrical, having leaves and flowers only at the top. The leaves are of great length, sometimes fifteen or twenty feet; and the flowers arranged in spadices; the fruit is generally a nut or drupe, as the cocoanut, date, &c. The only palm commonly growing in Europe is the **dwarf palm** (*Chamærops humilis*).

The palm trees are very useful to man; **cocoa-nuts, dates, wax, vegetable ivory, palm sugar, canes, sago, palm oil**, and many other things are obtained from one or other part of the plant.

§ 101. The order **Lilaceæ** contains plants mostly bulbous, with sessile leaves, flowers with coloured calyx and corolla, superior ovary and succulent fruit.

The type of the order is the **wild tulip** (*Tulipa sylvestris*).

The order comprises the genera **Lilium, Tulipa**, and **Convallaria**, or lilies and tulips; and the genera **Allium** and **Asparagus**, or onion, garlic, and asparagus, common vegetables.

§ 102. The order **Orchidaceæ** contains plants remarkable chiefly for the peculiar structure and shape of their flowers, which have petals, and the stamens and style consolidated into a single piece, calyx adhering to ovary.

The type of the order is the **spotted orchis** (*Orchis maculata*).

The structure of these flowers is very peculiar and interesting, but would require too much space for full description. The most striking thing is the curious resemblance of the petals (especially the lower one), to different insects in shape, especially to bees, spiders, flies, lizards.

§ 103. The order **Irideæ** contains plants with tuberous or fibrous roots, alternate leaves, terminal inflorescence, flowers with six petals, stamens and carpels three each, fruit a capsule.

The type of the order is **spring crocus** (*Crocus vernus*).

The plants of this order are crocuses and flags. The former are very pretty wild flowers, from the stigmas of which saffron is obtained.

§ 104. The order **Juncaceæ** comprises waterside plants with fascicular roots, fistular leaves, capitular inflorescence, calyx and corolla forming a glumaceous perianth, six stamens, capsular fruit.

PLATE XVIII.

CLASS ACROGENS.

	ORDERS.	CHIEF GENERA. (Subdivision of Orders.)	SPECIMENS.
Having Stem and Leaves distinguishable from each other.	**FILICES.** *Ferns.* Growing almost everywhere.	*Adiantum*	maiden hair fern.
		Nephrodium	male fern.
		Asmunda	flowering fern.
		Ptoris	common brakefern.
		Scolopendrium	hart's tongue.
	LYCOPODIACEÆ. *Club Mosses.* Growing in damp places.	*Lycopodium*	common club moss.
	EQUISETACEÆ. *Horsetails.* Growing in ditches and rivers.	*Equisetum*	water horsetail. field horsetail.
	MUSCI. *Mosses.* Growing on damp stone or wood.	*Bryaceæ*	hair moss.
		Tungermamiraceæ	moss on damp wood or stone.
Stem and Leaves not distinguishable.	**FUNGI.** *Mushrooms, Mould.* Growing in fields and on walls, in dark and shady places.	*Agericus*	mushroom.
		Lycoperdon	puff ball.
		Puccina	mildew.
		Juber	truffle.
	LICHENES. *Lichenes.* Growing in rocky places, on heaths, trees, &c.	*Parmelia*	yellow lichen.
		Lecanora	cudbear.
		Scyphophorus	cup lichen.
	ALGÆ. *Sea Weeds.* Growing in water.	*Melanospermeæ*	kelp algæ.
		Rhodospermeæ	eatable dulse.
		Chlorospermeæ	sea purse.

The type of the order is the **soft rush** (*Juncus effusus*).

The order is very unimportant, in many respects resembling the Liliaceæ.

§ 105. The order **Cyperaceæ** contains plants with fibrous roots, three cornered solid stems, sheathing leaves, glumaceous flowers, fruit a nut.

The type of the order is the **cotton sedge** (*Eriophorum polystachyum*).

The plants of the **Cyperaceæ** are cut for making baskets, chairbottoms, mats, &c. The genus **Eriophorum** has cottony bristles used for stuffing, but they have not consistency enough for weaving.

§ 106. The order **Gramin** comprise a vast variety of plants, some of them of immense use to mankind for food; and others of equal value as food and fodder for cattle.

The type of the order is the **common wheat** grown in fields for making flour (*Triticum vulgare*).

The order comprises **wheat, oats, barley, rye, rice,** of use as food for man, besides a vast quantity of grasses used for haymaking.

They are generally herbs, with rhizomas, fistular culms, or stems, covered with a thin coat of flint, and glumaceous flowers; in either spikes or panicles; stamens generally two styles generally two.

ACROGENS.

The **Filices** or **Ferns** are the most highly developed of the **acrogens.** They have a rhizomatous stem with long leaf-like branches called **fronds**, on which small leaves are closely arrayed. The reproductive organs, instead of being flowers with calyx, corolla, stamen, and pistil, are very small capsules of seed arranged on the leaves, or at the apex of the **frond.** How they are fertilized, and whether there are any stamens or pistils on a minute scale, or flowers of two sorts, are questions not yet satisfactorily answered.

The type of the genus, **Adiantum, maiden hair fern,** is found chiefly on rocks or walls in damp places. It is a dark green plant, no stem, leaves about a foot long, divided into thin, delicate leaflets. The **male fern** (*Nephrodium Mas*) has bi-pinnate leaves, with oblong leaflets. The genus **Osmund**, the **flowering fern** (*Osminda regalis*), has also bi-pinnate **fronds**. The genus **Pteris** contains the most common species of ferns, growing, from a foot to five or six feet high, from a rhizoma.

In all these genera, the reproduction is on the same plan, by means of very minute seeds in very minute capsules, placed in groups on the backs of the **fronds**, as the leaves are called, or on contracted leaves, or sometimes enclosed within the edges of the **fronds**. The seeds are called **spores**; the capsules are called **thecal**; a group of capsules is called a **sorus**; and the thin membrane often spread over them is called an **indusium**.

Varieties of the fern tribe are the **male fern** (*Nephrodium filex mas*); the **maiden hair fern** (*Adiantum capillus veneris*); the common **fern** or **brake** (*Ptera aquilina*); and the **flowering fern** (*Osmunda regalis*).

The order **Lycopodiaceæ** contains plants resembling ferns in their method of fructification, and mosses in their general appearance. They have stems sometimes erect, on which small scale-like leaves are closely arranged. The **thecæ** or spore-cases are placed in the axils. The capsules are two-celled.

The common **club moss, Lycopodum clavatum**, is a type of the order.

The order **Equisetaceæ** comprises plants having a distinct stem, surrounded at intervals by whorls of leaves, having the **spore cases** arranged in cones at the end. The type of the order is the **Water horsetail** (*Equisetum fluviatile*) and the **field horsetail** (*Equisetum arvensis*). All the horsetails are coated with silica or flint, in the same manner as the **culm** or stems of grasses. Dutch rushes is another name for these plants.

The order **Musci** or **mosses** contains plants of a very small size, but of very interesting character. They are never of greater height than a few inches, and are frequently so small that they cannot be even seen distinctly without a microscope. They appear to be composed entirely of cellular tissue. The seeds or **spores** are contained in little capsules shaped something like urns, and often covered by a moveable lid. The green stain seen on damp walls or posts is a thin covering of moss **spores**, which soon grows thicker into complete plants. The type of the order is the common **hair moss** (*Polytrichum commune*), found on any heath.

The order **Fungi** contains plants of much variety, varying from the mushroom growing in the field to the height of some inches, to the extremely minute mildew and smut that settles on the corn in the fields, and destroys it. They may be described as bodies of cellular tissue, more or less of irregular shape, growing upon decaying matter, whether vegetable or animal, especially in damp and shady places, and reproduced by **spores.** A good type of the order is the common **mushroom** (*Agaricus campestris*).

The order **Lichenes** comprises one of the lowest forms of vegetable existence, growing where no other plants can. The stem and leaves are not distinguishable from each other, and the whole plant is of cellular tissue, apparently finding sufficient nourishment in the moistness of the atmosphere. The **spores** are contained in small vessels, frequently buried in the mass of the plant. Varieties of the order are the **reindeer moss** (*Cladonia rangiferina*) upon which the reindeer feed, and the **Iceland moss** (*Cetraria islandicus*) much used as a medicine.

The order **Algæ** contains plants growing in water, varying in size from being so small as to be invisible without a microscope to being a hundred feet long. They are frequently like immensely long leaves, some wide, and some mere threads. They are reproduced by **spores**, sometimes in **thecæ** along the surface, sometimes within the substance of the plant.

Kelp and **Iodine** are obtained from sea-weeds.

THE LINNEAN SYSTEM.

§ 107. This classification of plants into **flowering plants** and **flowerless plants**, and into the classes **exogens**, **endogens**, and **acrogens**; and of **exogens** into subclasses **thalamifloræ**, **calycifloræ**, **corollifloræ**, and **monochlamydeæ**; and of these into **orders**, and of the orders into **genera**, is called the **natural** arrangement, because the plants are arranged according to their general **nature**, taking into consideration **all the parts** of the plant and its manner of growth.

Before, however, this great work of arranging the whole of the plants in the world into one **system**, many attempts were made at other plans of arrangement, but all failed, more or less, because they were *not* natural arrangements, that is, the whole nature and character of each plant was not taken into account.

One system, however, has held its ground, though it is considered as inferior to the natural arrangement, because it is complete, easy of use, as far as it goes, and is really a kind of stepping-stone to a natural arrangement. This is the **Linnean system**, arranged by Linnæus, a Swedish botanist, who took for the grounds of classification the number of stamens in the flowers. By counting the stamens in the flowers, supposing you had a perfect specimen, you know at once in what **Linnean class** to place it.

Plates XIX. and XX. shew the twenty-four classes into which Linnæus arranged all plants, and also shew clearly the nature of each class, so far as the system takes notice of it, which is chiefly the number and arrangement of the stamens in the flower.

§ 108. This arrangement brings together all kinds of plants, whether **exogens** or **endogens**, but the **acrogens** are still a distinct class, on account of their having no stamens to count. They are for this **reason** put by themselves in a **class** called **cryptogamia.**

PLATE XIX.

Illustrations of the First Thirteen Orders of the Linnean System.

CLASSES.

1. MONANDRIA.
One stamen.

2. DIANDRIA.
Two stamens.

3. TRIANDRIA.
Three stamens.

4. TETRANDRIA.
Four stamens.

5. PENTANDRIA.
Five stamens.

6. HEXANDRIA.
Six stamens.

7. HEPTANDRIA.
Seven stamens.

8. OCTANDRIA.
Eight stamens.

9. ENNEANDRIA.
Nine stamens.

10. DECANDRIA.
Ten stamens.

11. DODECANDRIA.
Twelve stamens.

12. ICOSANDRIA.
Twenty or more, adhering to calyx.

13. POLYANDRIA.
Twenty or more, free from calyx.

Each Class has some of the Nine Orders here given.

ORDERS.

MONOGYNIA.
One style.

DIGYNIA.
Two styles.

TRIGYNIA.
Three styles.

TETRAGYNIA.
Four styles.

PENTAGYNIA.
Five styles.

HEXAGYNIA.
Six styles.

HEPTAGYNIA.
Seven styles.

DECAGYNIA.
Ten styles.

DODECAGYNIA.
Twelve styles.

PLATE XX.

Illustrations of Linnean Orders, Fourteen to Twenty-four.

CLASSES.		ORDERS.	
14. DIDYNAMIA. Four stamens, two shorter.		**GYMNOSPERMIA.** Naked seeds.	
		ANGIOSPERMA. Enclosed seeds.	
15. TETRADYNAMIA. Six stamens, two shorter.		**SILICULOSA.** Long pods.	
		SILIQUOSA. Short thick pods.	
16. MONADELPHIA. All the stamens united.		Various Orders, named according to the number of stamens in each flower.	
17. DIADELPHIA. Stamens in two bundles.			
18. POLYADELPHIA. Stamens in many bundles.			
		ÆQUALIS. Stamens and pistils.	
		SUPERFLUA. Some no stamens.	
19. SYNGENESIA. Small flowers growing in heads.		**NECESSARIA.** Flowers of two kinds stamen, no pistil, one stamen, the other pistil.	
		FRUSTRANEA. Some very imperfect.	
		SEGREGATA. The flower distinctly separated.	

PLATE XX.—*continued.*

Illustrations of Linnean Orders, Fourteen to Twenty-four.

CLASSES.		ORDERS.
20. GYNANDRIA. Stamens and pistils growing together.		Several Orders named from the number of stamens in each flower.
21. MONŒCIA. Flowers of two kinds on the same plant.		
22. DIŒCIA. Flowers of two kinds on different plants.		
23. POLYGAMIA. Three kinds of flowers with stamens only, pistils only, and both stamens and pistils.		Various Orders.
24. CRYPTOGAMIA. Plants having no flowers at all.		

As these classes were some of them very large, it became necessary to sub-divide them, and Linnæus did this upon a plan equally simple, that is, having taken the **stamens** as the ground of division into **classes**, he took the **styles** of the pistil as a ground for sub-division of classes into **orders**.

§ 109. The Linnean system is very *imperfect*, sometimes very *unnatural*, but also *generally very useful* to **beginners** in botany. If one knowing but little of the science had a plant put before him of which he knew nothing, he would not know how to begin to find out what it was. To find its place in the natural system, he ought to have a good knowledge of the arrangement of that system; but by the aid of the Linnean system he can find its place in both systems.

By counting the stamens he at once finds the class in the Linnean system to which it belongs; by counting the styles he also finds out to what order in that class. He then need only look through the descriptions of the genera in that order until he finds one answering to the plant.

This supposes the specimen to be a perfect one, and even then occasional difficulties will come in the way, (but without hard work no one can be a botanist). However, having found the genera in the Linnean system, a reference to the same genera in any book of the natural system will generally give the name of the natural order to which the genus belongs, and thus the position of the plant in **both orders** is readily found.

§ 110. For example, supposing the plant to be a **tulip**, an examination of the flower will shew six stamens, therefore it belongs to the class **hexandria**. The one style shews it to belong to the order **monogynia**. By looking over the descriptions in any Linnean book of the genera in the class hexandria and order monogynia, it will be soon found that the plant belongs to the genus **tulipa**. Now in any book of the natural system the genus tulipa will be found to be a division of the natural order liliaceæ, so that with the help of the Linnean system to start with, it is generally very easy to find out the name of an unknown plant, and its place in both the natural and Linnean systems.

The Linnean system is often called the artificial system.

PART IV.

ALPHABETICAL LIST OF COMMON BRITISH PLANTS.

THIS list gives the names of the more common British plants, with a few words on the nature and uses of each. There are three names to each: 1st, the *common* name; 2nd, the name according to the *natural* arrangement; 3rd, the name according to the *Linnean* arrangement. For example, the first plant mentioned: the **alder** is the *common* name, that by which every body knows it; according to the *natural* arrangement of plants it is one of the *order* **betulaceæ** (see § 96), and belongs to the *genus*, or *subdivision of order*, called **alnus**. According to the *Linnean* arrangement the alder belongs to the class **monandria**, and order **tetragynia**, which is expressed by the shortened form, **mon. tet.** The alder belongs to the *subdivision* (or *genus*) of **mon. tet.** called **alnus**.

The three names, *common*, *natural*, and *Linnean*, are shewn thus:

Common name, **alder** tree.

Natural name: class, **exogen**; natural order, **betulaceæ**; genus, **alnus**; species, **glutinosa**.

Linnean name: class, **monandria**; order, **tetragynia**; genus, **alnus**; species, **glutinosa**.

The Linnean name is put in parentheses, and with it is put also the name of the **genus** and **species** of the plant. These are *generally the same* in both the natural and Linnean arrangements.

Natural order is shortened into *nat. ord.*, and *genus* into *gen.*

ALDER, nat. ord. **betulaceæ**; gen. **alnus**; (*Alnus glutinosa*, mon. tet.)

A tree with alternate leaves, flowers of two sorts, one with stamens, the other with pistil, in catkins; fruit, a nut. The alder grows in low ground by the side of rivers. The wood is pretty and easy to work, and being but little affected by damp, is much used for building under water. The bark also produces tanning, and dyes are made from the bark and leaves.

ALGÆ, seaweeds, (crypt. alg.).

Varieties of these are:—

Common seagrape, (*Sargassum vulgare*).

Consisting of fronds with leaves, globular receptacles or seed cases, arranged in a raceme in the axils of the leaves.

Sea tree, (*Halidry's siliquosa*).

A common British alga, with a long frond, short branches, with air vessels and receptacles.

Sea catgut or **sea laces**, (*Chorda filum*).

A frond like a cord, about a quarter of an inch thick, and some thirty or forty feet long, hollow, jointed, with spore cases covering the whole length; used as ropes.

Eatable alaria, (*Alaria esculenta*).

A long frond, some ten or fifteen feet long, with leaves nearly a foot in length and fleshy; the sporules are in receptacles, covering a great part of both surfaces of the leaflets.

ANEMONE, nat. ord. **ranunculaceæ**; gen. **anemone**; (*Anemone pulsatilla*, poly. poly.).

Herb, with short stem, leaves in whorls, very much divided flowers, with only a perianth, solitary, fruit bearded.

A garden plant, not easy of cultivation near towns, with rich deep purple flowers, and prettily divided leaves.

APPLE, nat. ord. **rosacea**; gen. **pomæ**; (*Pyrus malus*, **Icos. di. pen.**).

A tree with ovate leaves opposite, flowers with calyx and corolla in an umbel, fruit a pome. The apple tree flowers in May, and is cultivated in all orchards for the sake of its fruit. The pear tree belongs to the same genus as the apple. The **crab**, a sour apple, is the one from which all the present varieties are derived. Most of our eatable apples were brought to England from the continent. The **nonpareil** was brought from France in the time of Queen Mary, but the **golden pippin**, one of the best of apples, is believed to be thoroughly English. **Cider** is made from apples, and was in common use in the seventeenth century.

ASH, nat. ord. **oleaceæ**; gen. **fraxinus**; (*Fraxinus excelsior*, **di. mon.**).

A tree with tall stem, branches, leaves, and flower-stalks opposite; leaves pinnated, with odd leaflet, flowers in panicles; the flowers have no calyx or corolla. Flowers in April. Fruit, a capsule.

These trees grow in Europe, Asia, and North America. The timber is valuable, especially as being very elastic, and thus useful for making wheels, bows, and for other purposes, such as hurdles, bowers, &c., where bending is required.

BEECH, nat. ord. **corylaceæ**; gen. **fagus**; (*Fagus sylvatica*, **mon. poly.**).

A tree with smooth bark, alternate leaves, flowers of two kinds. Fruit, a nut.

The beech is valuable chiefly for its wood, which is close grained and durable under water. It spreads very much, looking very stately. Its roots run very close to the surface, preventing any other plants growing near. The fruit, called **beech-masts**, are common food for wild animals.

Beet, nat. ord. **chenopodiaceæ**; gen. **beta**; (*Beta vulgaris*, **pen.** di.).

Herbs, large fleshy roots, stem short, leaves generally alternate, undivided; flowers, with calyx and no corolla; seeds, kidney shaped.

This is grown largely as food for cattle, and is also sometimes used as salad. **Sugar** in considerable quantities, and of good quality, can be extracted from the root, but is more expensive than the common cane sugar.

Birch, nat ord. **betulaceæ**; gen. **betula**; (*Betula alba*, **mon. poly.**).

A tree with light coloured bark, alternate leaves; flowers of two kinds; fruit, a nut.

The birch is a very graceful tree, frequently growing beside streams, into which the end of its long branches generally dip. Coleridge calls it "the lady of the wood." The smaller branches are tied in bundles and used as a rough kind of broom. The wood also is tough and generally used, but is not so durable as the oak or chestnut.

Blackberry, nat. ord. **rosaceæ**; gen. **rubus**; (*Rubus fruticosus*, **icos.** pol.).

A shrub with prickly stem, divided leaves; flowers with calyx and corolla, in panicles, generally pink; fruit, several juicy grains, fixed upon a spongy receptacle.

A very common plant in England, flowering in July and August, and ripening in September. The fruit is very pleasant and much eaten. In South Wales the blackberries grow as large as gooseberries.

Buttercup, nat. ord. **ranunculaceæ**; gen. **ranunculus**; (*Ranunculus acris*, **poly. poly.**).

A herb with erect stem, trifid leaves, flowers with calyx and corolla; solitary fruit, a group of follicles.

A common field plant, called buttercup from an old notion that they gave their peculiar colour to butter when cows fed on them, but it is very doubtful if cows eat them at all.

CABBAGE, nat. ord. **cruciferæ**; gen. **brassica**; (*Brassica oleracea*, **tetra. siliq.**).

Herb, with long fleshy root, large leaves, flowers with calyx and corolla, in a raceme; fruit, a silique.

The cabbage is cultivated for its leaves, which are eaten when boiled.

The various kinds, **savoy, broccoli, cauliflower, kale,** &c., are all derived from the common cabbage here mentioned.

The chief varieties of the cabbage are the **red cabbage, white cabbage, Savoy, Brussels' sprouts, cauliflower,** and **broccoli.**

The white and red cabbages are known at once by their colour and firm close growth; the Savoy has wrinkled leaves; the Brussels' sprouts have wrinkled leaves, and grow some feet high, with fresh sprouts; the cauliflower has a number of undeveloped flower buds; and the broccoli is a variety of the cauliflower, with darker leaves.

CARROT, nat ord. **umbelliferæ**; gen. **daucus**; (*Daucus carota*, **pent. di.**).

Herb, with thick fleshy root, pinnate leaves, flowers with calyx and corolla, in umbels; fruit double.

The carrot, like the parsnip and turnip, is cultivated for its root, which is a very useful vegetable. It was first brought to England in the time of Queen Elizabeth by the Flemings. In the time of James I. carrot leaves were used as ornaments for ladies hair.

CHERRY, nat. ord. **rosaceæ**; gen. **prunus**; (*Prunus cerasus*, **icos. mon.**).

A tree with lanceolate leaves, white flowers, with calyx and corolla, in umbels; fruit, a drupe.

The cherry tree is grown both for its fruit and for its ornamental appearance. Kent is especially famous for growing good cherries. It is said that the tree was first brought to Kent from France in the fifteenth century, but some kind of cherries were sold in the streets of London still earlier.

CHESTNUT, nat. ord. **corylaceæ**; gen. **castanea**; (*Castanea vulgaris*, **mon. poly.**).

A tree with alternate leaves; flowers of two kinds; fruit, a nut.

The chestnut is a very stately and beautiful tree, the wood of which is pretty, hard, and durable; the fruit, chestnut, is a common eatable fruit.

CLOVER, nat. ord. **leguminoseæ**; gen. **trifolium**; (*Trifolium repens*, **dia. dec.**).

Herb, with creeping stem; leaves divided in three prettily marked flowers in close bunches at end of stem; fruit, a legume.

The clover is very useful for food for cattle. The white flowers look very pretty in thick clusters. Another variety is the **red clover**, very good for mowing down.

COLUMBINE, nat. ord. **ranunculaceæ**; gen. **aquilegia**; (*Aquilegia vulgaris*, **poly. hex.**).

Herb, with ternate sessile leaves; flowers, with calyx and corolla, both coloured, in axils of leaves; fruit, a follicle.

A garden plant, with pretty flowers, generally purple, the petals having curiously twisted spurs, projecting beyond the calyx.

COWSLIP, nat. ord. **primulaceæ**; gen. **primula**; (*Primula veris*, **pen. mon.**).

Herb, resembling the primrose in having wrinkled obovate leaves, narrow at bottom, underground stem or rootstalk; and the flowers in umbels, but on stalks.

The cowslip flowers at nearly the same time as the primrose; the flowers are smaller and more numerous than in the primrose.

CURRANTS, nat. ord. **grossularieæ**; gen. **ribes**; (*Ribes* pent. mon.).

Red currant, (*Ribes rubrum.*)

Black currant, (*Ribes nigrum*).

Shrubs, with alternate leaves, broad; flowers in racemes, growing from axils of leaves; fruit, a berry, the cell full of pulp.

This plant is grown in gardens for the sake of the fruit, which is very wholesome and agreeable. The **white currant** is a variety of the red. **Gooseberries** belong to the same genus as currants. The currant is believed to be a native of England.

Daisy, nat. ord. **compositæ**; gen. **bellis**; (*Bellis perennis*, **syn. super.**)

Herb, with fibrous root, no stem, spoon-shaped leaves, yellow flower, growing together in close bunches with involucrum.

This simple little flower is called day's-eye, or daisy. It is very pretty as a flower, but troublesome as a weed.

Dandelion, nat. ord. **compositæ**; gen. **leontodon**; (*Leontodon taraxacum*, **syn. æq.**).

Herb, with long divided leaves, small flowers growing together in heads; fruit with feathery appendages.

A weed with pretty flowers, but very troublesome; useful only as medicine.

Elder, nat. ord. **caprifoliaceæ**; gen. **sambuscus**; (*Sambuscus nigra*, **pent. tri.**).

A bushy tree with trifid leaves, whitish flower, with calyx and corolla in cymes; fruit, a berry.

It is cultivated chiefly for its berries, from which wine is made, but also for its wood. It is a native of England, grows fast, but never becomes a large tree. The leaves and flowers are used in medicine.

Elm. nat. ord. **ulmaceæ**; gen. **ulmus**; (*Ulmus campestris*, **pen. di.**).

Tree, stem of hard, dark-coloured wood, with crooked grain; leaves oval in shape, rough; flowers in round bunches, with very short pedicels, calyx, but no petals; fruit, a membraneous samara, that is, having wings.

The elm tree grows chiefly in the South of England, flowering in April.

The wood is tough and hard, and resists damp, whence it is used for rough water-pipes and for coffins; also much found in parks and pleasure grounds.

EVERLASTING PEA, (*Lathyrus latipolius*, **dia. dec.**).

A climbing herb with broad, divided leaves and tendrils, crimson flowers, large and papilionaceous, with calyx and corolla; fruit, a legume.

Noticeable only for its pretty flowers, not wholesome.

FERNS, (**crypt. fili.**).

Common polypody, nat. ord. **polypodiaceæ**, gen. **polypodium** (*Polypodium vulgare*).

A fern with frond deeply pinnatifid, the pinnules being bluntly lanceolate, growing about a foot high; the sori, or spore cases, arranged on either side the midrib.

Blunt shield fern, nat. ord. **aspidiæ**; gen. **aspidium**; (*Aspidium filix mas.*).

A fern with alternate fronds doubly-pinnatifid, and spore cases only on one side the midrib, growing some four feet high.

Common wall spleenwort, nat. ord. **asplenise**; gen. **splenium**; (*Asplenium trichomanes*).

A fern with opposite pinnate fronds, with oblong spore cases, arranged parallel on both sides the midrib.

FLAX, nat. ord. **linaceæ**; gen. **linum**; (*Linum usitatissimum*, **pen. pen.**).

A shrub with lanceolate sessile leaves alternate, purple flowers with calyx and corolla, in panicles; fruit, a capsule.

This plant is cultivated for its fibrous bark, from which linen and lint are made. It was first brought from Egypt to Europe, and to England about the twelfth century. It is not much grown in England, however, as it impoverishes the ground very much, and it is found cheaper to import what is required from Russia, Holland, and America. The plant blossoms in June and July, and it is gathered in before the seed fully ripens, because, at that time, the fibres are best. The seeds will still ripen if the plants be stacked, and left a sufficient time. Linen is made from the fibre of the bark, and linseed oil and oil-cake, for cattle, from the seed.

Furze, or **Gorse**, nat. ord. leguminoseæ, gen. ulex; (*Ulex Europæus*, dia. dec.).

A shrub, with branched, spiny stem, yellow papilionaceous flowers, with calyx and corolla, growing in axils of spines; fruit a legume.

The furze bush is noticeable for its lovely blossoms opening in May. The great botanist Linnæus is said to have fallen on his knees in ecstacy, when he first saw a large extent of furze in full flower.

Globe Flower, nat. ord. ranunculaceæ; (*Trollius Europæus*, poly. poly.).

A herb with palmate leaves, flowers with many sepals and petals, both coloured; fruit a follicle.

This is called globe flower, because its yellow flowers have the sepals and petals closing over the stamen, giving it a round shape.

Gooseberry, nat. ord. grossulariaceæ; gen. ribes. (*Ribes grossularia*, pen. mon.).

This pleasant fruit grows on a shrub (belonging to the same genus as the currant,) having alternate broad leaves, flowers growing on separate stalks; the calyx is turned backward; fruit, a berry, only growing in cool climates, and believed to be native in England.

Grass, nat. ord. graminaceæ; (*Triandria Dygynia*); a glumal endogen.

The genera and species of grass are almost endless. Some of the most useful are;—

Common cat's tail grass, (*Pleum pratense*).
Meadow fox tail grass, (*Alopercurus pratensis*).
Common oat like grass, (*Arrhenatherum avenaceum.*)
Sweet scented vernal grass, (*Anthoxanthum·odoratum.*
Rough stalked meadow grass, (*Poa trivialis*).
Cock's foot grass, (*Dactylis glomerata*).

Evergreen herbs, with fibrous or bulbous roots, and cylindrical stems, generally hollow (closed at joints) covered with a very fine coating of flint; leaves narrow, with split sheath; flowers green, in spikes or glumes; no calyx or corolla, but flowers enclosed by bracts.

HAWTHORN, nat. ord. **rosaceæ**, gen. **cratægus**; (*Cratægus oxyacantha*, **icos. mon.**)

A shrub, frequently forming hedges, with alternate leaves and flowers, with calyx and corolla, in corymbs; fruit, a red berry. The hawthorn flowers in May, whence its pretty white, pink, and red blossoms are called May. The fruits are called haws, whence the plant is called hawthorn. The birds eat largely of the red berries.

HAZEL, nat. ord. **corylaceæ**, gen. **corylus**; (*Corylus avellana*, **mon. mon.**).

Generally a shrub, with alternate leaves, flowers of two kinds; fruit, a nut.

The wood is much used for making walking sticks, and fishing-rods, and also for making **charcoal**. **Filberts** and **cobnuts** probably form a cultivated species of the hazel.

HEATH, nat. ord. **ericaceæ**, gen **erica**; (*Erica*, **oct. mon.**)

A beautiful evergreen, of small size, with narrow leaves, generally in whorls. Flower, with calyx and corolla, sometimes in tufts, sometimes in racemes; fruit a capsule.

Varieties of the heath are;—

Cornish heath, (*Erica vagans*).
Cross leaved heath, (*Erica tetralix*).
Fine leaved heath, (*Erica cinerea*).

Of these the Cornish is, perhaps, the prettiest. In autumn the hills of Cornwall glow with beauty, from being covered with this lovely little plant. The heath also affords food to sheep, goats, and birds. Some species of it are also useful in poor, mountainous regions for thatching houses, and for mixing with clay to make walls.

HELLEBORE, nat. ord. **Ranunculaceæ**; gen. **Helleborus**; (*Helleborus*, **poly. poly.**).

Three varieties are:—
Green hellebore, (*Helleborus viridus.*)
Stinking Hellebore, bear's foot, (*Helleborus fœtidus.*)
Black hellebore, Christmas rose, (*Helleborus niger*).

Herbs, with divided leaves, flowers, with generally only a perianth; fruit a capsule.

The green hellebore has wide spreading green flowers; the stinking hellebore globular pale green flowers in panicles; the black hellebore has a white flower appearing in January, whence its title of Christmas Rose. All the hellebores are dangerous.

HOLLY, nat. ord. **Aquifoliaceæ**; gen. **Ilex**, (*Ilex aquifolium*, **tet. tet.**).

Evergreen trees or shrubs, leaves alternate or opposite, flowers small in axillary branches, fruit pulpy with four cells and a seed in each, growing in woods, hedges, and thickets, flowering in May, the fruit lasting through the winter.

Bird lime is made from the bark. At Christmas when flowers are not obtainable, the holly branch is a pretty ornament, and much used, together with mistletoe, for decorating houses and churches.

HONEYSUCKLE, nat. ord. **Caprifoliaceæ**; gen. **Lonicera**; (*Lonicera pariclymenum*, **pen. mon.**).

A shrub, leaves opposite on a twining stem, the flowers in terminal groups.

This beautiful plant flowers in May, June, and July, and sheds a most pleasant perfume, especially after rain. It is of very common cultivation, almost entirely for its beauty and fragrance.

HOP, nat. ord. **Urticaceæ**; gen. **Humulus**; (*Humulus lupulus*, **diœc. pen.**).

A climbing herb, with opposite leaves, flowers of two kinds; fruit a capsule.

The hop plant is cultivated extensively, especially in Kent, for the catkins of fruits, which are picked off before fully ripe, and used in making beer to prevent it turning sour. The fruit is also used in medicine to induce sleep.

HORSE RADISH, nat. ord. **Cruciferæ**; gen. **Cochlearia**; (*Cochlearia armorica*, **tetra. sili.**).

Herb, with large leaves, numerous small white flowers, with calyx and corolla, in axil of leaf, in racemes; fruit a silicle.

This is a weed, useful only for its root, scrapings of which are eaten with roast beef.

IVY, nat. ord. **Araliaceæ**; gen. **Hedera**; (*Hedera helix*, **pen. mon.**).

A shrub with long climbing branches, leaves alternate, flowers with calyx and corolla, growing in umbelliferous heads; fruit a berry, covered by calyx, containing five cells with one seed in each.

This picturesque shrub flowers in October, ripening in the following spring. It spreads over old walls, churches, houses.

LARKSPUR, nat. ord. **Ranunculaceæ**; gen. **Delphinium**; (*Delphinium consolida*, **poly. di. pen.**).

Herb, with leaves divided into very narrow leaflets, pretty blue flowers, with calyx and corolla, the petals spurred, in racemes; fruit a capsule.

This pretty plant is cultivated for its beauty. It has generally blue petals, but occasionally white or pink.

LETTUCE, nat. ord. **Compositæ**; gen. **Lactuca**; (*Lactuca sativa*, **syn.** **seq**.).

Herb, with saw-edged leaves clasping the stem, small yellow flowers growing in bunches in panicles; fruit, small nuts with hairy wings.

The lettuce is cultivated for the sake of its leaves as a cool salad. From some varieties, and especially from the wild lettuce (*Lactuca virosa*), a milky juice is extracted which resembles opium as a medicine.

LICHENS, (cryp. lich.).

Rose-coloured mushroom lichen, (*Bæomyces roseus*).

A plant roughly resembling a mushroom in shape, but not so distinct in form, the stem and head being more nearly the same in thickness. The lower part of stem a pale green, the top, called the apotheca, the place of the spores, a pale rose colour; growing on the ground on heaths and moors.

Yellow sessile calicum, (*Calicium tigilare.*)

A minute plant, thallus bright green, the top, which changes to dusty seed, is dark; grows on damp wood, trunks of trees, &c., very small in size.

Cudbear, (*Lecanora tartarea*).

The plant is one of the largest lichens, being occasionally nearly half an inch thick. It consists of a greyish thallus partly surrounded by a flesh coloured apotheca, or seed case. It is sold in a powdery form to make dye for cloth.

Iceland Moss, (*Cetraria Islandica*).

The thallus green or light brown, apotheca dark brown. Imported from Iceland and Norway as useful in coughs and consumption.

Reindeer Moss, (*Cladonia rangifera*).

A lichen with stem branching, each branch bearing apothecæ on short branchlets. Growing in Lapland to a foot in height, covering the ground for immense distances, and affording food to the reindeer.

LIME, nat. ord. **Tiliaceæ**; gen. **Tilia**; (*Tilia*, **poly. mon.**).

Varieties of this tree are:—

Common lime or linden tree, (*Tilia Europa*).

Broad leaved lime, (*Tilia grandifolia*).

Small leaved lime, (*Tilia parvifolia*).

Trees of large size, with alternate leaves, flowers, with calyx and corolla in cymes, fruit and leathery ball. The wood of the lime is light but durable, the bark is tough and pliable and much used for making cords, baskets, mats, &c. It is not a native of England, but has grown here since the sixteenth century. It is a great favourite for avenues and public places, from its bright green leaves and fragrant flowers.

LYCOPODII, (**cryp. lyc.**)

A group of plants between the mosses and the ferns.

Club moss, (*Lycopodium clavatum*).

A plant between a moss and a fern, with creeping stem, a great number of small fine leaves closely arranged on erect branches, each terminating in one or more thickish spikes made up of bracts containing thecæ or spore cases.

MAPLE, nat. ord. **Aceraceæ**; gen. **Acer**; (*Acer campestre*, **oct. mon.**).

A tree, with opposite leaves, flowers, with calyx and corolla, in corymbs, growing in the axils of the leaves; fruit a winged capsule.

The wood of the maple tree is very pretty and much used for ornamental work. Another variety, the **sugar maple**, (*acer saccharinum*), growing in North America, is a very lofty tree with white bark. When the sap of this tree begins to ascend, holes are bored in the trunk, out of which the sap runs into troughs laid ready for it. From this sap, sugar of very fine quality is extracted.

MISTLETOE, nat. ord. **Loranthaceæ**; gen. **Viscum**; (*Viscum album*, **diœ. tetra.**).

Parasitical plants, fixing their suckers under the bark of various trees, and living upon their sap; with opposite fleshy leaves; flowers of two kinds; fruit a white berry.

A plant of peculiar appearance; flowers small and hard; used at Christmas, with holly, to decorate houses.

MOSS, nat ord. **musci**; (*Cryp. mus.*).

Silvery thread moss, (*Bryum argenteum.*).

Growing on banks, walls, roofs, &c. Short stems, with very small leaves, closely imbricated. Seta about half-inch high, supporting a brown theca or seed-case.

The leaves terminate in five silvery points, whence its name.

In other thread mosses the seta sometimes rises two or three inches above the leaves.

Ostrich plume feather moss, (*Hypnum cristá castrensis.*).

A feather moss, growing on mountains; its stems and leaves resembling an ostrich feather. Seta about two inches high; with drooping thecæ.

Golden maiden hair moss, (*Polytrichum commune*).

A large moss, with simple stem, fine leaves not very closely arranged; setæ growing from end of stem, with erect thecæ; growing from two inches to a foot in height.

Sharp leaved earth moss, (*Phascum cuspidatum*).

A moss with short stem; leaves with midrib extending beyond the body of leaf (whence the name "sharped leaved"); thecæ nearly sessile amongst the leaves.

NETTLE, nat. ord. **Urticaceæ**; gen. **Urtica**; (*Urtica*, **mon. tet.**)

Varieties of the nettle are;—

Common nettle, (*Urtica dioica*).
Small nettle, (*Urtica urens*).
Roman nettle, (*Urtica pilulifera*).

The nettles are herbs, with erect, spiny stems; opposite leaves, flowers of two kinds, growing in axils of leaves. Fruit, a capsule.

The nettles are remarkable in many ways. Some are covered, stem, leaves, and flowers, by prickles, containing juice more or less poisonous.

The fibre is very tough and flexible, being often used as a substitute for hemp.

In hot climates the nettle often grows to be a tree.

OAK, nat. ord, **Corylaceæ**; gen. **Quercus**; (*Quercus*, **mon. poly.**).

Varieties of the oak are

Common oak, (*Quercus robur*).
Sessile fruited oak, (*Quercus sessiliflora*).

A tree, with alternate leaves; flowers of two kinds; fruit, an acorn.

Oaks are cultivated chiefly for their wood, which is very durable, and much used in ship-building. The bark, also, is useful for dyeing and tanning; **cork** is the bark of one species (*Quercus suber*). The fruit is much used as food for pigs. **Galls** are produced on one species (*Quercus impectoria*), by insects, and are useful as medicine; and *quinine*, a very valuable medicine, is obtained from the bark of a species of oak growing in Peru.

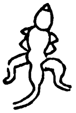
ORCHIS, nat. ord. **orchidaceæ**; gen. **orchis**; (**gyn. mon.**).

Varieties of the orchis are;—

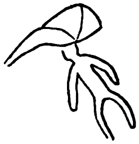
Lizard orchis, (*orchis hircina*).
Early purple orchis, (*orchis mascula.*)

Herbs with tuberous roots, sheathing leaves, flowers with calyx and corolla, arranged in a spike.

This plant is only ornamental. The flowers are very beautiful, being marked with various colours, with the petals turned and twisted in very curious ways. The petals are arranged in **lizard orchis** so as to resemble the legs and long tails of lizards crawling up the plant, whence its name. In another variety the **green man orchis** (*Aceras anthropophora*) the lower petals present a grotesque resemblance to men hanging by their heads to the flowers.



(Lower Petal of *lizard orchis.*)



(Flower of *man orchis.*)

PÆONY, nat. ord. **Ranunculaceæ**; gen. **Pæonia**; (*Pæonia officinalis*, **poly. di. pen.**).

Herb with alternate leaves, large flowers, with calyx and corolla, solitary. Fruit, a follicle.

The pæony is valued for its handsome flowers; in which are mingled the colours of crimson, white, and purple.

PARSNIP, nat. ord. **Umbelliferæ**; gen. **Pastinaca**; (*Pastinaca sativa*, **pent. dig.**).

Herb with long fleshy root; pinnate leaves; flowers, with calyx and corolla, in umbels. Fruit double, that is, growing in pairs.

This plant is cultivated for its root, which is very sweet and pleasant; when boiled as a vegetable it is eaten with meat.

PEA, nat. ord. **Leguminosæ**; gen. **Pisum**; (*Pisum sativum*, **dia. dec.**).

Climbing herb, with pinnate leaves and tendrils; flowers, with calyx and corolla, papilinaceous; fruit, a legume.

The pea is extensively cultivated for its seeds. When they are fleshy, the legumes or pods are picked off the plant; and the young seeds are taken out for eating when boiled.

PEAR, nat. ord. **Rosacea**; gen. **Pyrus**, (*Pyrus communis*, icos. di. pen.).

A tree, with simple ovate leaves, flowers, with calyx and corolla, grow in a corymb; fruit a pome, like the **apple**, which belongs to the same genus as the pear tree. Is grown in almost all orchards for the sake of its pleasant fruit. It is supposed to have been first brought to England by the Romans, but many of the better sort have been more recently brought from France. **Perry is made from pears, as cider is from apples.**

PINE TREE, nat. ord. **Coniferæ**; gen. **Pinus**, (*Pinus sylvestris*, mon. dia.).

A tree, with very narrow leaves growing in pairs, flowers of two kinds in clusters; fruit a hard conical body with the seeds naked on the outside of it, covered only by scales.

The wood of the pine tree is much used in ordinary carpentering work, as it is soft and easily worked. **Pitch, turpentine**, and **tar** are obtained from the sap of the fir-tree, as is also **resin**. **Pine** is another common name for fir, but pine and fir are not the same, though very much alike.

POPLAR, nat. ord. **Salicaceæ**; gen. **Populus**, (*Populus*, diœ. oct.).

A large, smooth tree, with large alternate leaves, flower of two kinds; fruit a leathery capsule.

Trees of good height, growing very straight and quickly, with close grained, tough, straight wood; the roots spread very widely and injure other plants near.

Other varieties are:—

The grey poplar, (*Populus canescens*).

The aspen tree, (*Populus tremula*), so called from its leaves always moving with the least motion of the air.

POPPY, nat. ord. **Papaveracea**; gen. **Papaver**, (*Papaver*, **poly. mon.**).

Varieties of this plant are:—

White poppy, (*Papaver somniferum*).
Corn poppy, (*Papaver rhœas*).

Herbs with alternate leaves, flowers with calyx and corolla, solitary; fruit a capsule.

The petals of the corn poppy are a bright crimson, from which they are always conspicuous when growing, as they usually do, amongst the standing corn.

From the white poppy, which has pretty white flowers tinged with purple, is made **opium**. This opium is the hardened juice of the white poppy, found in all parts of it but the seeds. The **opium poppy** is cultivated, for the sake of the opium, in India.

PRIMROSE, nat. ord. **Primulaceæ**; gen. **Primula**, (*Primula vulgaris*, **pen. mon.**).

Herb, with short stem, leaves thick and curled, generally in tufts, flowers in sessile umbels, calyx small, corolla with petals partly united, the limbs spreading out flat; fruit a capsule.

This pretty plant flowers in early spring, growing wild by hedges and road sides. The **cowslip** is another species of this genus.

RADISH, nat. ord. **Cruciferæ**; gen. **Raphanus**, (*Raphanus sativus*, **tetr. sili.**).

Herb, with long or globular fleshy stem, divided leaves, yellow flowers, with calyx and corolla, in corymbs, growing in leaf axils; fruit a silique.

The radish is cultivated for its edible root; said to be a native of China. The chief varieties are the **long radish** and the **turnip shaped radish**. They are only good for eating when young.

ROSE, nat. ord. **Rosacea**; gen. **Rosa**, (*Rosa*, **icos. poly.**).

The chief varieties of the rose are:—
Common dog rose, (*Rosa canina*).
Sweet briar or **eglantine**, (*Rosa rubiginosa*).
Cinnamon rose, (*Rosa cinnamomea*).

The cultivated roses are not in their natural states; a natural rose has but one row of petals, and numerous stamens. By cultivation many of the stamens are converted to petals, thus making the beautiful double flower known as the garden rose.

Generally, a rose plant is a shrub with prickly stems, pinnate leaves, large flowers, either white, red, or yellow, with five sepals, five petals: fruit generally a nut.

RUSH, nat. ord. **Juncaceæ**; gen. **Juncus**, (*Juncus conglomeratus*. **hex. mon.**).

Plants somewhat resembling grasses, but differing from them in having a more or less solid stem, not jointed, and generally with the edges more or less sharp.

The common rush has a tall stem, with the flowers, with only a perianth, growing out at one side, towards the top, in a close bunch: fruit a capsule.

Rushes grow in moist soils, sometimes where no other plant will. The rush is very useful. It is used for making the small candles called rush lights, and also very much for making mats and basketwork. In the sixteenth century, the better kind of houses in England were strewed with rushes, as the best carpet that could be produced at that time. On low and loose coasts, such as Holland, the rush does good work by matting its long roots together in the ground and so helping to keep the earth together. For this purpose the Dutch plant the **great sharp sea-rush**, (*juncus acutus*), a stately rush growing some six feet high, with long roots, flower in large panicles, fruit large capsules, is much used. Another useful variety is the **soft rush**, (*juncus effusus*).

SEDGE, nat. ord. **Cyperaceæ**; gen. **Carex**, (**mon. tri.**).

Varieties of the sedge are:—
Common sea carex, (*Carex arenaria*).

Lesser common carex, (*Carex paludosa*).
Greater common carex, (*Carex riparia*).

The sedges differ from grasses in having a solid stem, without nodes, and with sharp edges, growing chiefly on boggy ground.

A creeping root, erect stem, sheathing leaves, flowers in glumes arranged in spikes, are common to all the three varieties here given, but the common sea carex is the smallest of the three, and the greater common carex the largest. The sedges are useful in their roots, like those of rushes, matting together and keeping the loose earth of shores together.

SHEPHERD'S PURSE, nat. ord. **Cruciferæ**; gen. **Capsella,** (*Bursa pastoris,* **tetra. sili.**).

Herb, with short stem, leaves, some pinnatifid and others entire, small white flowers; fruit a silicle.

A common weed, growing almost anywhere.

SNAPDRAGON, nat. ord. **Scrophulariaceæ**; gen. **Antirrhinum,** (*Antirrhinum majus,* **did. ang.**).

Herb, with erect bushy stem, long narrow leaves, flowers with calyx and corolla in a raceme; fruit a capsule.

A pretty plant, common on walls and cliffs. The flower is prettily shaped and contains honey, the corolla is a kind of tube with one lid closing over the mouth and the other spread open above.

STRAWBERRY, nat. ord. **Rosacea**; gen. **Fragaria,** (*Fragaria elatior,* **icos. poly.**).

Herb, increasing by running stems rooting at joints, leaves in three leaflets, flowers with calyx and corolla generally white: fruit small nuts on a fleshy receptacle.

The cultivated strawberry, like the rose, is not the same as the wild varieties. Gardeners grow the plants with a view to getting as much, and as delicious, fruit as possible. For this purpose, the different varieties are mixed, until it is difficult to assign its exact place in classification to any particular plant. The one mentioned here, the **haut-bois strawberry**, is one that produces large and pleasant fruit. The fruit of the strawberry is probably the most delicious grown in Britain, and the best is to be found growing in Scotland, near Edinburgh.

THISTLE, nat. ord. **Compositæ**; (syn. seq.).

Varieties of the thistle are:—

Milk thistle, (*Silybum marianum*).
Common cotton thistle (*Onopordum acanthium*).
Spear plume thistle, (*Cnicus lanceolatus*).

The varieties of thistle are almost endless, but all agree in general outlines, being spiny herbs, with sharp edged leaves, purple flowers in close heads, and hairy or feathery appendages to the fruit. They are of little or no use, and of extreme trouble as weeds difficult to be got rid of.

TRAVELLER'S JOY, nat. ord. **Ranunculaceæ**; gen. **Clematis**, (*Clematis vitalba*, poly. poly.).

Herb, with climbing stem, with divided leaves, opposite, petiole twining, flowers, with calyx but no corolla, in panicles; fruit a follicle with a long plume.

A wild climbing plant with white flowers, growing in hedges and thickets.

TULIP, nat. ord. **Liliaceæ**; gen. **Tulipa**, (*Tulipa gesneriana*. hex. mon.).

A bulbous plant, with gaily coloured perianth; fruit a capsule.

This gorgeous flower, grown in gardens for its beauty, was first brought to Europe from Constantinople in the sixteenth century. In the seventeenth century, the Dutch grew many beautiful varieties, which then sold for enormous sums, one being said to have fetched £500. The plant was introduced into England, but Holland is still the chief place for raising tulips.

TURNIP, nat. ord. **Cruciferæ**, gen. **Brassica**, (*Brassica rapa*, **tetra. siliq.**).

Herb, with globular fleshy root, rough leaves, small flowers, with calyx and corolla, in a corymb: fruit a silique.

The turnip is cultivated chiefly for its root, which is eaten with boiled mutton. Also it is food for cattle. It has been cultivated since the time of our Saviour.

VIOLET, nat. ord. **Violaceæ**; gen. **Viola**, (*Viola odorata*, **pen. mon.**).

This lovely and sweet-scented flower grows wild in shady places. It has a fibrous root, short stem, heart-shaped leaves, with calyx and corolla, the latter velvety and irregular in shape. Flowers for a short time in March and April.

WALL-FLOWER, nat. ord. **Cruciferæ**; gen. **Cheiranthus**, (*Cheiranthus cheiri*, **tetra. siliq.**).

Herb, with shrubby stem, lanceolate alternate leaves, flowers, with calyx and corolla, in a raceme; fruit a silique.

The plant is valued for its pretty and fragrant flowers, which open in April and May. The wild flowers are yellow; when cultivated the colours are varied.

WATER-CRESS, nat. ord. **Cruciferæ**; gen. **Nasturtium**, (*Nasturtium officinale*, **tetra. siliq.**).

Herb, with pinnate leaves, small white flowers, with calyx and corolla, in a raceme; fruit a silique.

This familiar plant grows in clear shallow water. It is much eaten as a salad. The leaf is always rounded in shape and with smooth edge. This should be remembered, as occasionally a similar plant gets mixed with watercress, and mistaken for it, the leaves of which are longer and narrower than the leaves of the cress, and with serrated edges. Watercress is a wild plant, but has lately become also a cultivated one, owing to the increased demand for it.

WATER-LILY, nat. ord. **Nymphæceæ**; gen. **Nymphæa**, (*Nymphæa alba*, **poly. mon.**).

An aquatic plant with large floating leaves, and large flowers, with calyx and corolla, with yellow stamens; fruit a capsule.

The water-lily roots in the mud at the bottom of quiet water, the leaves floating on the surface. The flower rises and opens in the morning, closing and lying on the surface at evening. Another variety is the **yellow water-lily**, (*Nuphar lutea*).

WILLOW, nat ord. **Salicaceæ**; gen. **Salix**, (*Salix*, diœ. dia.).

Varieties are:—

Common white willow, (*Salix alba*).
Common osier, (*Salix viminalis*).
Shining dark green willow, (*Salix laurina*).
Grey sallow, (*Salix cinerea*).

Trees or shrubs, with alternate leaves, flowers of two kinds on different plants; that is, some plants having only flowers with stamens, other plants having only flowers with pistils: fruit a capsule.

Small willows are much used for **basket-work**, **hoops**, or for any purpose for which strength and flexibility are wanted. The larger trees give good timber. The bark is useful for tanning.

YEW, nat. ord. **Pinnaceæ**, gen. **Taxus**, (*Taxus baccata*, diœ. mon.).

An evergreen tree, with narrow short leaves, flowers of two kinds in small catkins, fruit a nut.

The yew grows thick, but not very high. Its wood is close grained and tough. The whole of the tree, except the fruit, is very poisonous. In times when **bows** and **arrows** were used, the wood of the yew was much valued for making **bows.**

INDEX AND GLOSSARY.

The numbers refer to the *sections* and not to the *pages*.

Achene, a small dry fruit not opening to let the seed out.
Aconite, 68.
Acorn, the fruit of the oak.
Acuminate, sharply pointed.
Acute, sharp.
Alder, 96.
Almond, 76.
Ammonia, a gaseous element of food of plants.
Ammonia, composition of, 47.
Anemone, 68.
Apex, the upper point.
Apple, 76.
Apricot, 76.
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Asparagus, 101.
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Awned, with a long spine.
Baneberry, 68.
Bark, the outer covering of exogen plants.
Barley, 106.
Beech, 94.
Berry, a one celled succulent fruit, many seeded.
Betulaceæ, 96.
Bi-dentate, doubly teethed.
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Bittersweet, 89.
Bi-serrate, sawlike, with the teeth also sawlike.
Bistort, 92.
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Branched, divided.
Branched fibrous, having fibres that are subdivided.
Branches, subdivisions of the stem.
Bryony, 78.
Buckbean, 88.
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Bulbous, being like a bulb.
Burdock, 83.
Butterbur, 83.
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Calyx, position of, 23.
Campanulate, resembling a bell.
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Capsule, a fruit, syncarpous, dry, opening to let the seed out.
Carbon, the chief element of the substance of plants.
Carbonic acid, a gaseous element of food of plants, 47.
Carpel, the lower portion of the pistil.
Carrot, 80.
Cartilaginous, being gristly.
Cassia, 99.
Catkin, a spike, which falls off, flowers and peduncles altogether
Caulinar, belonging to the stem.
Celandine, 69.
Cellular tissue, soft spongy tissue
Centaury, 88.

Chamomile, 83.
Chestnut, 94.
Cinnamon, 99.
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Cirrhous, ending in a tendril.
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Comose, hairy.
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Cone, the fruit of the Coniferæ, conical, with naked seeds.
Conical, shaped like a cone.
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Connate, two leaves growing together.
Contour, outline.
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Convolvulus, 86.
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Corymb, a raceme with the flowers on the same level.
Cotyledons, seed leaves.
Cowslip, 85.
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Cruciate, resembling a cross.
Cucumber, 78.
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Curvinerval, with curved nerves.
Cuspidate, rounded off abruptly.
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Cylindrical, pipe shaped.
Cyme, a panicle with flowers on a level.
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Dentate, toothlike.
Denticulate, with small teeth.
Dichotomous, forked.
Digitate, resembling fingers.
Difference, between classes, 61.
Difference, between plants, 56.
Dimidiate, in halves.
Dock, 92.
Dodder, 86.
Dog violet, 72.
Drupe, a succulent fruit with an internal stone.
Drupel, a small drupe.
Egg plant, 89.
Elm, 97.
Emarginate, being cut at the edge.
Embryo, the growing point of the seed.
Equitant, one leaf partly covered by the one below it.
Fascicled, in bundles.
Fastigiate, pressed close.
Fennel, 80.
Fibres, very slender branches.
Fibrous, having fibres.
Fig, 93.
Filiform, threadlike.
Filum, resembling a thread.
Fir, 98.
Flags, 104.
Flax, 73.
Fleshy, soft but firm.
Flexous, bendable.
Floral, belonging to the flower.
Floral envelope, description of, 32
Flower, parts of, 22; description of, 28; arrangement of parts in, '31; exogen and endogen.
Food, description of, 45; gaseous. 46; elements of, 47; mineral, 48; absorption of, 51.
Food, mineral and gaseous substances, which, when absorbed by it, nourish a plant.
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Fruit, the ripened ovary, containing the seed.
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Fusiform, spindleshaped.
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Gibbous, projecting.

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Grasses, 106.
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Ground ivy, 90.
Grumose, heaped.
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Head, flowers crowded close together, surrounded by a bract.
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Hemlock, 80.
Hemp, 93.
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Hornbean, 94.
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Imbricate, one leaf partly covering the one beside it.
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Keeled, shaped like the keel of a boat.
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Labiate, lip-like.
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Lobed, divided.
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Marsh violet, 72.
Medullary ray, processes of cellular tissue connecting the pith and bark of an exogen.
Melon, 78.
Midrib, the central vein.
Mistletoe, 82.
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Neck, the part of a plant where stem and root meet.
Nettle, 93.
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Nut, fruits that are dry, syncarpous and indehiscent.
Nymphaceæ, 70.
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Oblique, more on one side than on the other.
Obtuse, blunt.
Oleaceæ, 87.
Olive, 87.
Onion, 101.
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Orchis, 102.
Osier, 95.
Oxlip, 85.
Oxygen, a gaseous element of food for plants.
Ovary, the seed case, lower part of the pistil.
Ovoidal, oval shaped.
Ovules, the seeds in their earlier stage.
Palmaceæ, 100.
Palm trees, 100.
Panicle, a raceme, with each peduncle redivided.
Panicled, divided into a compound raceme.
Pansy, 72.
Papaveraceæ, 69.

Papilionaceous, resembling a butterfly.
Parsnip, 80.
Parsley, 80.
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Peach, 76.
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Pectinate, resembling a comb.
Pedicel, subdivision of a peduncle or flower-stalk.
Peltate, shield-shaped.
Penninerved, resembling a feather.
Peppermint, 90.
Petals, leaves of the corolla.
Petiolate, belonging to the petal.
Petiole, the stalk of a leaf.
Phyllodium, a body like a leaf.
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Pine, 98.
Pinnate, divided into small leaflets.
Pistil, organ of the flower containing the ovary.
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Pith, the centre of the stem of an exogenous plant.
Plane, flat, level.
Plant, parts of, 1.
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Plumule, the part of the root that becomes the stem.
Pollen, the small powder contained in the anthers.
Pollen, shapes of, 26.
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Pome, a fruit resembling an apple.
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Primordial, earliest leaves of the plant.
Primrose, 85.
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Pungent, sharp.
Ràceme, flowers on pedicles along a stem.
Radiate, spreading from a centre.
Radical, belonging to the root.
Radish, 71.
Rameal, belonging to the branches.
Ranunculaceæ, 68.
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Retuse, blunt.
Rhizomatous, belonging to a root stalk.
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Root, the extremity of a plant that draws in food, &c.
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Root-stalk, an underground stem.
Root-stock, an underground or creeping stem.
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Rush, a solid stalk.
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Samara, a fruit with wings.
Sap, the food of plants.
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Scales, undeveloped leaves.
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Seed, the part of a plant that will reproduce it.
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Seminal, belonging to the seed.
Sepals, leaves of the calyx.
Serrate, saw-like.
Serrulate, saw-like with small teeth.
Sessile, without a stalk.

Seta, resembling a bristle.
Setose, hairy or bristly.
Sheathing, surrounding the stem.
Silique, a pod-like fruit.
Solitary, flowers standing alone.
Solonaceæ, 89.
Sorrel, 92.
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Sow-thistle, 83.
Spadix, flowers in a head, enclosed.
Spike, sessile flowers along a stem.
Spongiole, the extremities of the roots, or of the root fibres.
Stamens, organs of the flower containing the pollen.
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Stem, the main body of a plant.
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Stipes, the stem of an endogen.
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Tissue-cellular, the soft, spongy part of a plant.
Tissue-vascular, the tough, stringy part of a plant.
Toad-flax, 91.
Tobacco-plant, 89.
Trapezoidal, with four unequal sides.
Trunk, the stem of a tree.
Truncate, cut off.
Tubers, swelling of root fibres into reservoirs of nourishment.
Tulips, 101.
Turnips, 71.
Ulmaceæ, 97.
Umbel, flowers or peduncles all starting from one point in the stem.
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Urticaceæ, 93.
Vascular tissue, tough and stringy tissue.
Vein, the division of a leaf.
Violaceæ, 72.
Violet, 72.
Wallflower, 71.
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Water-lily, 70.
Water-melon, 78.
Wheat, 106.
Whorl, three or more leaves growing together.
Willow, 95.
Wood, the vascular tissue of some plants.
Yellowwort, 88.
Yew, 98.

THE END.

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